DK SMITHSONIAN

Corinthian helmet

Viking helmet

German armet

Çiçak helmet

Samurai helmet

Pickel haube

German infantry helmet

Kevlar infantry helmet

Flint arrowhead

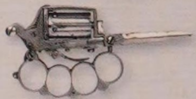
Apsis shield

Viking axhead

Proto mortuary sword

Spanish cavalry pistol

Rast and Gasser M1898 pistol


Dolne Apache pistol

Tokarev TT pistol

MILITARY HISTORY

THE DEFINITIVE VISUAL GUIDE TO THE OBJECTS OF WARFARE

Mons Meg bombard

12-pounder cannon

Maxim machine gun

Panzer

Howitzer

Sherman Firefly

Rapier missile launcher

Grant M3A3

Fokker Dreidecker

Fairey Swordfish

Messerschmitt Bf 109

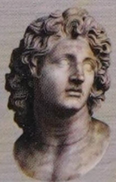
P-51 Mustang

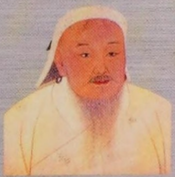
Avro Lancaster

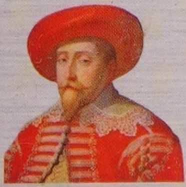
F-86F Sabre

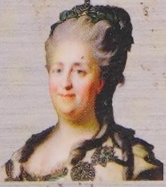
Chinook CH-47

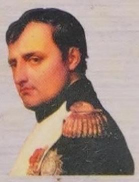
Sukhoi SU-27

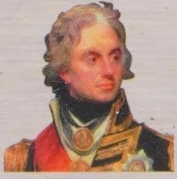

Alexander the Great

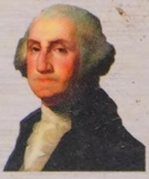

Ghengis Khan


Gustavus Adolphus


Catherine the Great


Napoleon Bonaparte


Horatio Nelson

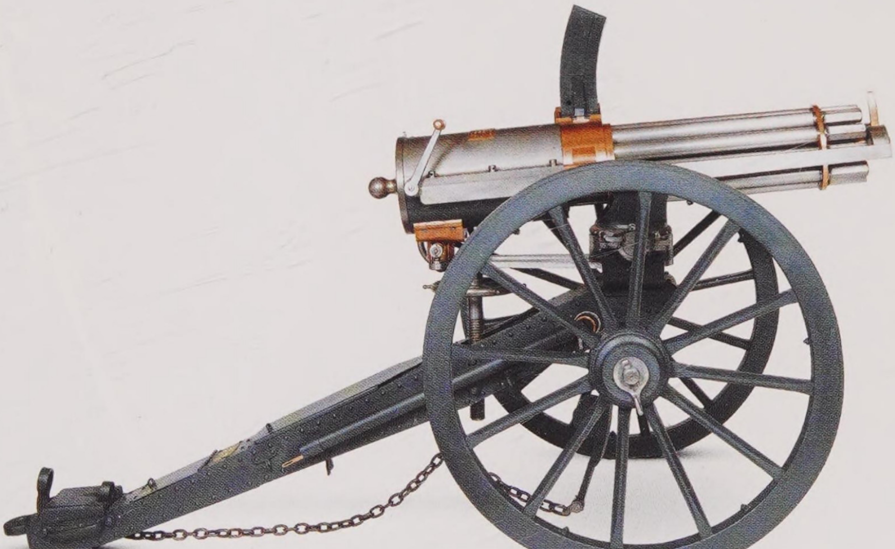

George Washington

Dwight D. Eisenhower

MILITARY

THE DEFINITIVE VISUAL GUIDE TO THE OBJECTS OF WARFARE

HISTORY



Smithsonian

MILITARY HISTORY

THE DEFINITIVE VISUAL GUIDE TO THE OBJECTS OF WARFARE

DK

DK | Penguin Random House

Senior Editor Gareth Jones
Editorial Team Hannah Bowen, Hugo Wilkinson, Alison Sturgeon, Steve Setford, Andy Szudek, Satu Fox
Senior Art Editors Michael Duffy, Sharon Spencer
Design Team Keith Davies, Steve Woosnam-Savage
Photographer Gary Ombler
Production Editors Ben Marcus, Tony Phipps
Production Controller Nancy-Jane Maun
Picture Research Sarah Smithies, Roland Smithies
Cover Designer Mark Cavanagh
Managing Editor Stephanie Farrow
Managing Art Editor Lee Griffiths
US Senior Editor Rebecca Warren
US Editor Jill Hamilton

Cobalt ID
The Stables, Wood Farm
Deopham Road, Attleborough
Norfolk NR17 1AJ
Managing Editor Marek Walisiewicz
Managing Art Editor Paul Reid
Editors Richard Gilbert, Louise Abbott
Art Editors Darren Bland, Lloyd Tilbury

DK India
Managing Editor Saloni Talwar
Senior Editors Neha Gupta, Priyanka Naib
Editorial Team Surbhi Nayyar, Suneha Dutta
Managing Art Editor Romi Chakraborty
Senior Designer Govind Mittal, Anis Sayyed
Design Team Pankaj Bhatia, Amit Varma, Honlung Zach
Senior DTP Designer Harish Aggarwal
DTP Designers Vishal Bhatia, Jagtar Singh, Dheeraj Arora
CTS Manager Balwant Singh
Production Editor Pankaj Sharma
Managing Director Aparna Sharma

Published by Dorling Kindersley Limited in association with Royal Armouries Trading and Enterprises Limited

First American Edition 2012
This edition published 2015

Published in the United States by
DK Publishing
1450 Broadway, Suite 801,
New York, NY 10018

Copyright © 2012, 2015 Dorling Kindersley Limited
A Penguin Random House Company

19 10 9 8 7 6 5 4
004—182907—Aug/2015

All rights reserved.
Without limiting the rights under copyright reserved above, no part of this publication may be reproduced, stored in or introduced into a retrieval system, or transmitted, in any form, or by any means (electronic, mechanical, photocopying, recording, or otherwise), without the prior written permission of both the copyright owner and the above publisher of this book.

Published in Great Britain by Dorling Kindersley Limited

A catalog record for this book is available from the Library of Congress.

ISBN 978-1-4654-3608-5

DK books are available at special discounts when purchased in bulk for sales promotions, premiums, fund-raising, or educational use. For details contact: DK Publishing Special Markets, 1450 Broadway, Suite 801, New York, NY 10018 or SpecialSales@dk.com.

Printed and bound in China

A WORLD OF IDEAS:
SEE ALL THERE IS TO KNOW

www.dk.com

CONSULTANTS

Smithsonian

This trademark is owned by the Smithsonian and is registered in the US Patent and Trademark Office

Established in 1846, the Smithsonian—the world's largest museum and research complex—includes 19 museums and galleries and the National Zoological Park. The total number of artifacts, works of art, and specimens in the Smithsonian's collections is estimated at 137 million, much of which is contained in the National Museum of Natural History, which holds more than 126 million specimens and objects. The Smithsonian is a renowned research center, dedicated to public education, national service, and scholarship in the arts, sciences, and history.

SMITHSONIAN ENTERPRISES
Carol LeBlanc, Vice President
Brigid Ferraro, Director of Licensing
Ellen Nanney, Licensing Manager
Kealy Wilson, Product Development Coordinator

SMITHSONIAN
Staff of the Division of Armed Forces History, National Museum of American History, Smithsonian

THE ROYAL ARMOURIES, UK
Thom Richardson
Keeper of Armour and Oriental Collections

Robert C. Woosnam-Savage
Curator of European Edged Weapons

Jonathan Ferguson
Curator of Firearms

Mark Murray-Flutter
Senior Curator of Firearms

Trevor Weston
Modern and Military Firearms Manager

Karen Watts
Senior Curator of Armour and Art

Nicholas Hall
Keeper of Artillery

Philip Magrath
Curator of Artillery

ADDITIONAL CONSULTANTS
Brian Lavery
Curator of Naval History, National Maritime Museum, Greenwich, UK

Stephen Woolford MBE
Head of Interpretation and Collections, Imperial War Museum, Duxford, UK

CONTRIBUTORS

R. G. Grant
Philip Parker
Ian Bottomley
Charles Phillips
Roger Ford
Adrian Gilbert
Malcolm Claridge

Weights and measurements given in this book are expressed in their metric and imperial equivalents, wherever the information is available. However, there are various different conventions for the measurements of caliber and displacement. Please refer to p.446 for further details.

INTRODUCTION

The development of arms and armaments is central to the story of military history. While the aims and intentions of humans at war have remained essentially the same since the very dawn of civilization, the history of weaponry and tactics has been a process of near-constant adaptation, reinvention, and progression, with the result that battlefield technology has grown increasingly effective, and ever more deadly.

The earliest weapons took the form of stone axes and clubs, but, with the adoption of bronze, and then iron, these were improved, developed, and then superseded. Swords, spears, and bows dominated the field of battle from the era of Ancient Egypt and Assyria to the high Middle Ages, until the introduction of gunpowder weapons in Europe in the 14th century. This invention heralded a sea-change in warfare, as human strength was aided and then all but replaced by chemical and mechanical power, a process that accelerated during the Industrial Revolution, with an exponential growth in the range and accuracy of weapon systems, both on land and at sea. War then reached the skies in the early 1900s, expanding the reach of military might across the globe, and, while the advent of the nuclear bomb in 1945 made the prospect of full-scale conflict almost too terrible to contemplate, it did not stop the pace of technological change in conventional arms during the rest of the century. In the modern age, the increasing sophistication of "smart" weapons has heralded a revolution in warfare, and we have reached an era in which human combatants are slowly being replaced by computer-controlled machines.

The following pages offer a beautifully illustrated account of this process, showcasing significant armaments and other military pieces across 5,000 years and a vast geographical range. However, this majestic book—a fruitful collaboration between leading military history writers and expert consultants from the Royal Armouries, the Smithsonian, and other specialist institutions—is much more than simply a catalog of weaponry. It offers gripping accounts of the key battles, landmark events, and historical figures whose legacies have changed the reality of warfare; it explores the role technologies and tactics played in determining the outcome of conflicts; and it charts the impact of these events on the balance of power and boundary, the rise and fall of nation and empire, and on the course of human history.

CONTENTS

Introduction 5

TO 500CE

CHARIOTS AND SWORDS

Introduction 12

Key Development: **The First Warriors** 14

Stone and Bone Weapons 16

Early Metal Weapons 18

Ancient Siege Warfare: **The Siege of Lachish** 20

Ancient Egyptian Weaponry 22

Key Development: **Hoplites and Phalanxes** 24

Hoplite Armor and Weapons 26

Phalanx and Cavalry: **The Battle of Issus** 28

A Greek Trireme: ***Olympias*** 30

Key Development: **The Roman War Machine** 32

Roman Legionary's Armor and Weapons 34

Key Development: **The Engineering of Roman Conquest** 36

Roman Fortification: **Arbeia** 38

Enemies of Rome 40

Key Development: **Asian Traditions** 42

An Ancient Chinese Army: **The Terracotta Warriors** 44

500–1500

KNIGHTS AND BOWMEN

Introduction 48

Key Development: **The Weapons of Early Medieval Europe** 50

Viking Weaponry and Armor 52

A Viking Longship: ***Havhingsten Fra Glendalough*** 54

Anglo-Saxons and Normans 56

Defeat of the Anglo-Saxons: **The Battle of Hastings** 58

Key Development: **Armored Cavalry in Medieval Europe** 60

Knights' Armor and Weapons 62

Full Steel Plate Protection: **Medieval Armor** 64

Knights' Helmets 66

A Clash of Knights: **The Battle of Bouvines** 68

European Swords 70

Key Development: **Medieval Infantry** 72

Infantry Armor and Weapons 74

Medieval Archers 76

Long Range Power: **Crossbow** 78

Knights and Bowmen: **The Battle of Crécy** 80

Key Development: **Sieges and the Art of Fortification** 82

Medieval Fortification: **Bodiam Castle** 84

Key Development: **Gunpowder Makes its Mark** 86

Siege Engines and Early Cannon 88

Key Development: **Arab and Turkish Conflict** 90

The Middle East 92

The Crusades 94

Key Development: **East Asian Warfare** 96

Mongol Armor and Weapons 98

Steppe Horsemen: **The Mongols at War** 100

East Asian Weapons and Armor 102

Fortification on a Grand Scale: **The Great Wall of China** 104

Key Development: **Warriors of Pre-Columbian America** 106

Pre-Columbian Weaponry 108

Clash of Civilizations: **Aztecs and Conquistadors** 110

1500–1680

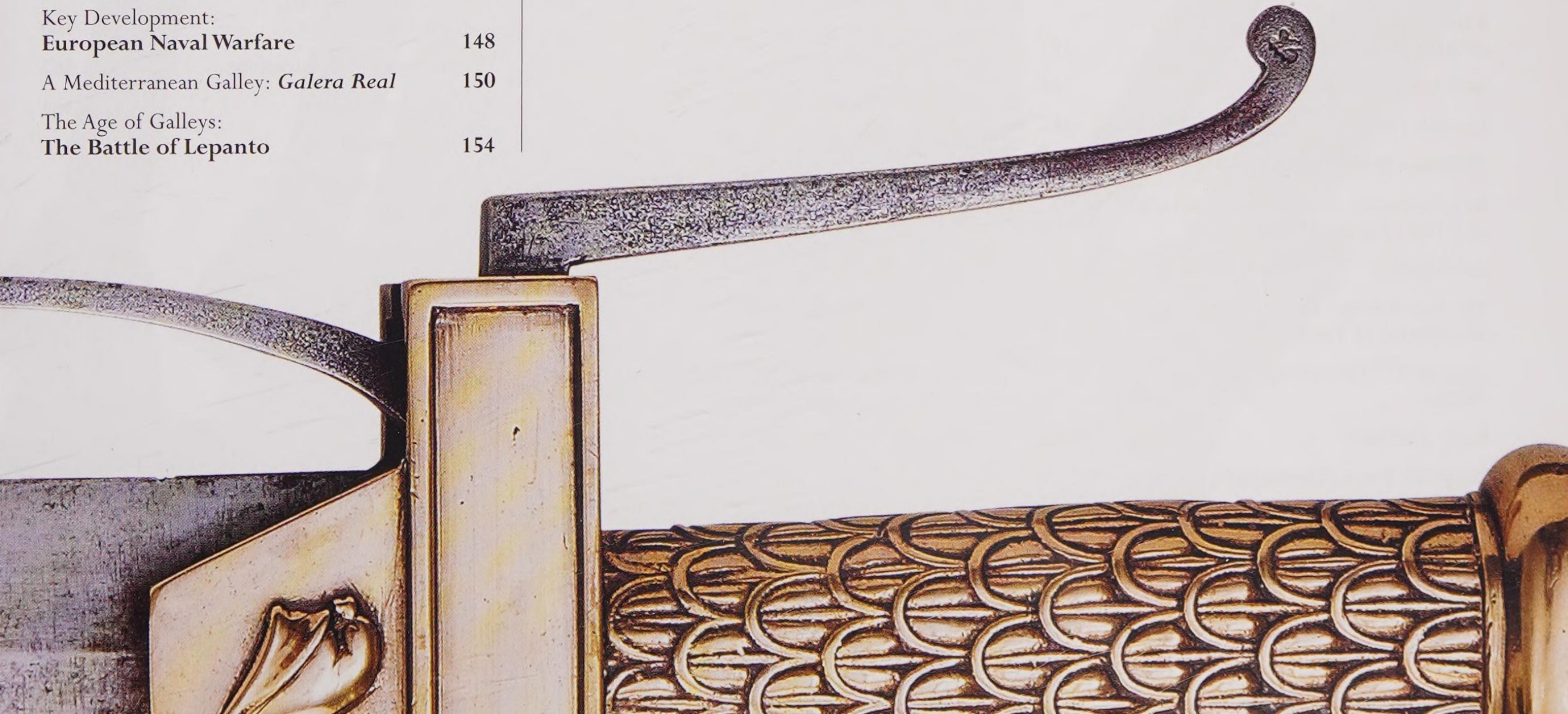
PIKES AND GUNPOWDER

Introduction 114
Key Development: **Pikes and Muskets** 116
Field Artillery and Naval Cannon 118
European Infantry Armor and Weapons 120
Simple But Effective Firearm: **Matchlock Musket** 122
Pikes and Matchlock Muskets: **The Battle of White Mountain** 124
Key Development: **From Lance to Pistol** 126
Cavalry Armor and Weapons 128
Key Development: **The Islamic Empires at War** 130
Ottoman Armor and Weapons 132
Cavalry and Cannon:
The Battle of Mohacs 134
Mughal Armor and Weapons 136
Key Development: **Warfare in East Asia** 138
East Asian Swords 140
East Asian Weapons 142
Japanese Armor 144
Samurai and Foot Soldiers: **The Siege of Osaka Castle** 146
Key Development: **European Naval Warfare** 148
A Mediterranean Galley: ***Galera Real*** 150
The Age of Galleys: **The Battle of Lepanto** 154

1680–1815

FLINTLOCK AND BAYONET

Introduction 158
Key Development: **18th-century Uniformed Armies** 160
Uniforms of European Armies 162
Plug, Socket, and Sword Bayonets 164
18th-century Swords 166
18th-century Guns 168
Flintlock Muskets and Bayonets: **The Battle of Fontenoy** 170
Riflemen of the American Revolution 172
Weapons, Uniforms, and Kit of the American Revolution 174
Key Development: **The Development of Siege Warfare** 176
Field Artillery and Naval Cannon 178
Early Modern Siege Warfare: **The Siege of Namur** 180
Key Development: **Armies of the Revolutionary Era** 182
French Revolutionary and Napoleonic Infantry 184
Uniforms of Chasseur and Cuirassier 186
British Uniform and Kit of the Napoleonic Wars 188
Weapons of the Revolutionary and Napoleonic Wars 190
Forefather of the Modern Rifle: **Baker Rifle** 192
Cavalry and Infantry Square: **The Battle of Waterloo** 194
Key Development: **Naval Battles in the Age of Sail** 196
Naval Guns and Kit 198
Carronnades and Other Naval Guns 200
Navigation and Communication at Sea 202
Naval Swords 204
Naval Warfare in the Age of Sail: **The Battle of the Nile** 206
Weapons, Uniform, and Kit of an Ordinary British Sailor 208
British Naval Officer's Uniform 210
18th-century British Ship of the Line: **HMS *Victory*** 212



1815–1914

INDUSTRY AND IMPERIALISM

Introduction 218

Key Development: **The Beginnings of Modern Warfare** 220

Flintlock Muskets and Breech-loading Rifles 222

Flintlock and Percussion Pistols, and Early Revolvers 224

Metallic-cartridge Pistols 226

Early Repeating Rifles 228

Uniforms and Insignia of 19th-century Armies 230

Early Industrial Warfare: **The Battle of Antietam** 232

American Civil War Uniforms 234

Infantry and Cavalry Swords and Bayonets 236

Muzzle-loading Artillery 238

Key Development: **The Wars of Empires** 240

Manually loaded Repeater Rifles 242

Machine-guns 244

A New Kind of Firepower: **Gatling Gun** 246

Breech-loading Artillery 248

Imperial Firepower: **The Battle of Omdurman** 250

Clothing and Weapons of Africa and Oceania 252

Self-loading Pistols 254

Guerilla Warfare: **Second Boer War** 256

Military Medals Before 1914 258

Key Development: **Steam, Ironclads, and the First Battleships** 260

Battleships 262

The Age of Steam and Big Gun: **The Battle of Tsushima** 264

Japanese Pre-Dreadnought Battleship: ***Mikasa*** 266

Early Cruisers 270

Torpedo boats, Destroyers, and Submarines 272

1914–1945

THE WORLD WARS

Introduction 276

Key Development: **Trench Warfare** 278

Uniforms and Equipment 280

Heavy Machine-guns 282

Light Machine-guns and Machine-pistols 284

World War I Defenses: **Bayernwald Trench** 286

Field Guns, Siege Guns, and Howitzers 288

Trench-fighting Weapons 290

Trench Warfare: **The Battle of Arras** 292

Tanks and Armored Vehicles 294

World War I Tank: **Mark V Tank** 296

Communications and Equipment of World War I 298

Key Development: **The Growth of Air Power** 300

Reconnaissance and Fighter Aircraft 302

Bomber Aircraft 304

Fighter and Fighter-bomber Aircraft 1939–1942 306

Fighter and Fighter-bomber Aircraft 1943–1945 308

Bomber Aircraft 1939–1942 310

Bomber Aircraft 1943–1945 312

World War II Long-range Heavy Bomber: **Boeing B-17 Flying Fortress** 314

Bombs and Missiles of World War II 318

Transport, Reconnaissance, and Liaison Aircraft 320

Communications and Codebreaking Equipment of World War II 322

World War Era Medals 324

Key Development: **Battles at Sea in the World Wars** 326

Capital Ships 328

Super Dreadnought Battleship: **USS *Texas*** 330

Cruisers 334

Destroyers and Escorts 336

Submarines 338

An Amphibious Invasion Force: **The Normandy Landings** 340

Key Development: **Air and Sea Battles** 342

Aircraft Carriers 344

Carrier and Maritime Strike Aircraft 346

Air–Sea Combat: **The Battle of Leyte Gulf** 348

Key Development: **Tanks and Infantry in World War II** 350

Allied Armored Fighting Vehicles 352

Axis Armored Fighting Vehicles 354

World War II Armored Vehicle: **T-34 Tank** 356

Anti-tank Weapons 358

Trucks, Half-tracks, and Light Vehicles 360

Uniforms and Equipment 362

Self-loading Rifles 364

Personal Weapons 366

Water- and Air-cooled Machine-guns 368

Artillery 370

Airborne Assault: **Operation Market Garden** 372

Airborne Forces Uniforms and Kit 374

Resistance Weapons and Equipment 376

Nuclear Warfare: **The Bombing of Hiroshima** 378

1945–PRESENT

THE NUCLEAR AGE

Introduction 382

Key Development: **The Cold War Era** 384

Nuclear Bombers and Interceptors 386

Nuclear Attack Submarine: **USS *Nautilus*** 388

Key Development:
Guerrillas and Terrorists 390

Assault Rifles 392

Infantry Firepower 394

US Marine Uniform and Kit 396

Close Air Support:
Operation Cedar Falls 398

Helicopters 400

Attack/Reconnaisance Helicopter:
AH-64 Apache 402

Special Forces Weapons 404

Medals of the Modern Era 406

Key Development:
The Contemporary Era 408

Fighter and Strike Aircraft 410

Stealth Ground-attack Aircraft:
Lockheed F-117 Nighthawk 412

Electronic Warfare and Reconnaissance Aircraft 414

Post-War Tanks 416

Infantry Uniforms and Equipment 418

Sniper Rifles 420

Modern Frigates and Destroyers 422

American Aircraft Carrier:
USS *George Washington* 424

Key Development:
The High-tech Battlefield 428

Ground-missile Destroyer:
USS *Donald Cook* 430

Post-war Submarines 434

Counterinsurgency:
Combat in Afghanistan 436

Glossary 438

Index 440

Acknowledgments 446

CLOSED
DRILL
17 65
XXXV

TO 500CE

CHARIOTS AND SWORDS

INTRODUCTION

Early humans developed weapons of wood and stone, such as clubs, axes, spears, and simple bows, for hunting and fighting; the growth of civilizations from around 3000BCE onward led to advances in both technology and organization.

The first military developments were slow, emerging over centuries, or even millennia. Stone weapons were gradually replaced by those of more effective materials—first copper and bronze, then iron and steel; meanwhile, missile weapons increased in range and penetrative power with the advent of the composite bow, and later, the crossbow. The invention of wheeled vehicles and the domestication of horses gave rise to the war chariot, which dominated battlefields from Egypt to China until, imitating the mounted warriors of central Asia, settled civilizations learned to fight on horseback. The building of fortifications led to the new art of siege warfare, and conflict also took to the sea, with oared war galleys operating in the Mediterranean by the 8th century BCE.

In ancient warfare, fighting methods and organization were generally more important to success than technological superiority. The Assyrians conquered an empire with the world's first permanent professional army, in the 1st millennium BCE, and the Romans ruled the most famous of ancient empires with an army of professional legionaries who also excelled as military engineers, building roads, bridges, forts, and frontier fortifications. The Greeks, meanwhile, won renown for their tactical skills—whether as infantry in their tightknit phalanx formations, or at sea, maneuvering their lightweight galleys, the triremes.

None of the settled civilizations, however, were safe against the nomadic peoples—or "barbarians" as they were known—outside their borders. The "civilized" technological advantages of torsion catapults and crossbows counted for little against bands of mounted warriors, who were highly skilled in raid and ambush. East and West Asia, India, and Europe all faced severe problems from incursions by central Asian nomadic horsemen.

KEY DATES

3000BCE

c.3000BCE Bronze weapons come into use in Mesopotamia

c.2500BCE The first recorded battle takes place between the Sumerian cities of Lagash and Umma

c.1600BCE The Hittites and Egyptians use chariots to carry archers with composite bows

c.1275BCE Hittite and Egyptian chariots clash at the Battle of Kadesh, in modern-day Syria

1210BCE The first recorded naval battle is fought between Hittites and Cypriots, off the coast of Cyprus

c.1200BCE The first iron weapons are produced

c.1000BCE The Assyrians establish a powerful military empire

c.900BCE Scythians fighting on horseback become the first known cavalry

c.701BCE The Assyrians besiege the Judean town of Lachish

700BCE The Greek city states develop phalanx tactics

632BCE Hundreds of war chariots are deployed at the Battle of Chengpu, in China

c.550BCE Cyrus the Great founds the Persian Empire

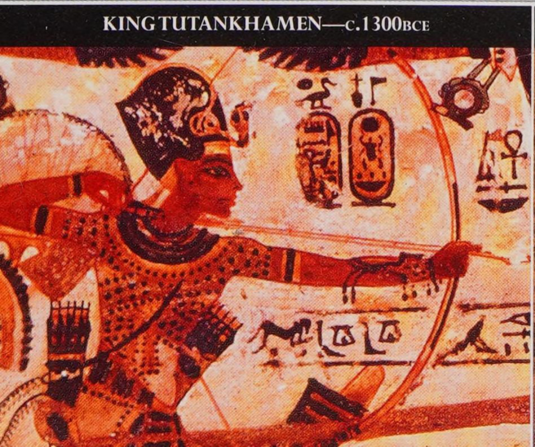
480BCE Greek triremes defeat the Persians at the naval Battle of Salamis, off the Greek Coast

c.450BCE The first crossbows are invented, in China

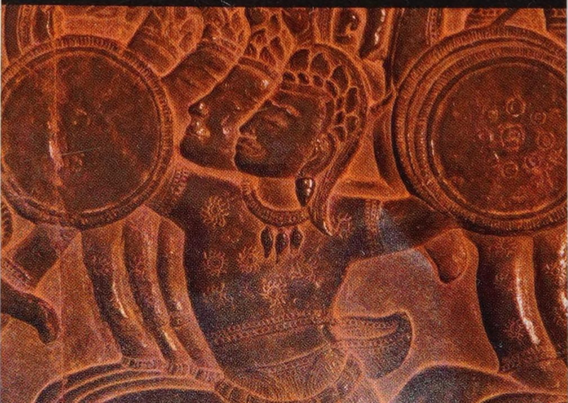
431–04BCE The Peloponnesian War is fought between Athens and Sparta

c.400BCE Dionysius of Syracuse introduces the ballista to the battlefield

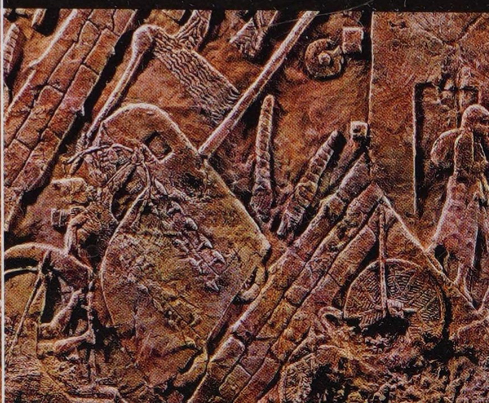
KING TUTANKHAMEN—c.1300BCE



THE MAHABHARATAS WAR—c.1300BCE



THE SIEGE OF LACHISH—701BCE



333–31BCE Alexander the Great of Macedonia defeats the Persian empire in battles at Granicus, near Troy, Issus, in Anatolia, and Gaugamela, in Persia

c.310BCE Chandragupta Maurya creates an empire in northern India with an army using war elephants

264–41BCE Rome defeats Carthage in the First Punic war

c.220BCE The construction of the first Great Wall of China

218BCE Carthaginian commander Hannibal leads an army across the Alps to attack Rome

c.210BCE The Terracotta Army is made for the Chinese Emperor Qin Shi Huang

202BCE The defeat of Carthage by Rome, at the Battle of Zama, ends the Second Punic War

107BCE The Marian reforms create professional Roman legions, armed with sword, javelin, and shield

52BCE Roman general Julius Caesar defeats the Gauls under Vercingetorix, at the Siege of Alesia

31BCE Octavian, the future Roman Emperor Augustus, defeats Mark Antony and Cleopatra, at the Battle of Actium, off the Greek coast

122CE The Romans begin the construction of Hadrian's Wall, in Britain

208CE In China, the Battle of Red Cliffs, on the Yangtze River, ends the Han dynasty

260CE Persian Sassanid Emperor Shapur I defeats and captures Roman Emperor Valerian at Edessa, Mesopotamia

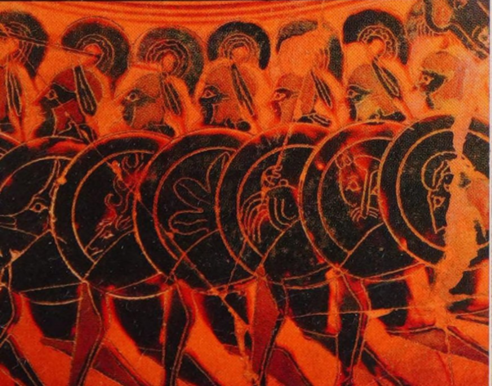
378CE Roman Emperor Valens is defeated by the Goths at the Battle of Adrianople, in Thrace

451–52CE The Huns, horsemen from central Asia, invade western Europe

476CE The fall of the western Roman Empire

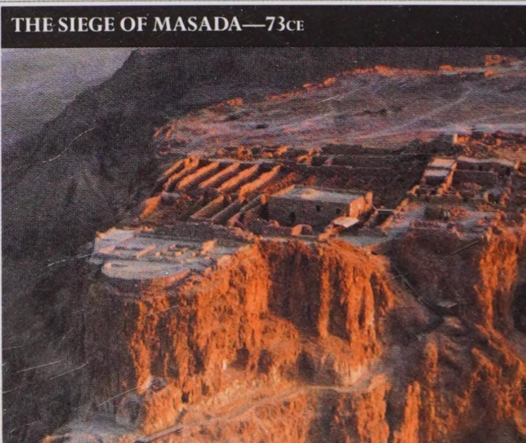
500CE

HOPLITES—c.500BCE



THE TERRACOTTA ARMY—c.200BCE

THE SIEGE OF MASADA—73CE

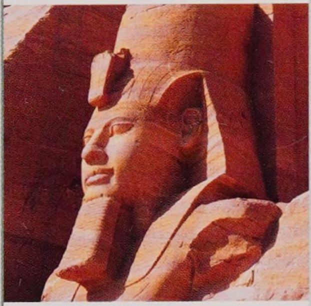


KEY **FIGURE**

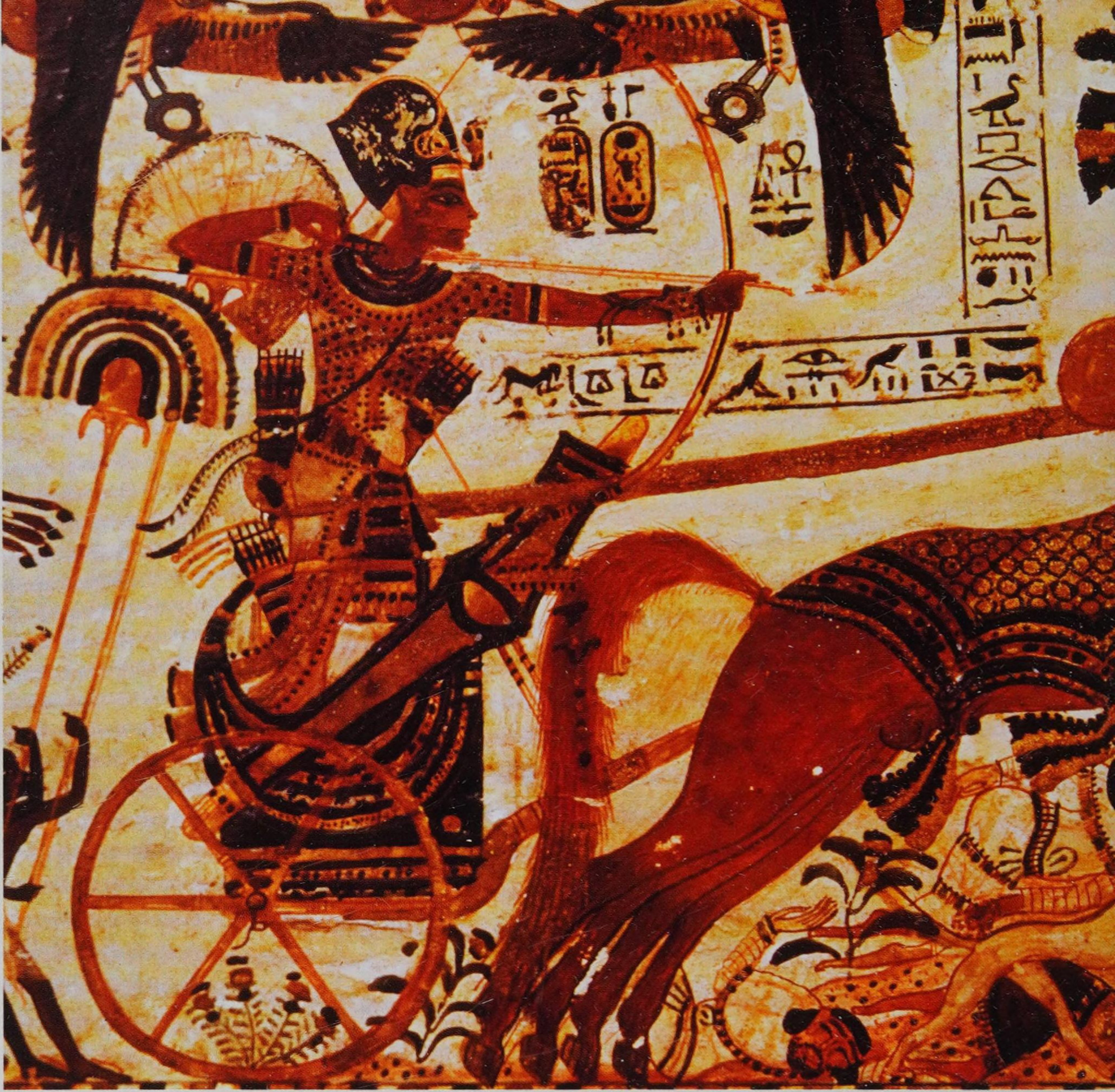
RAMESSES II

1279–1213BCE

One of the longest-reigning Egyptian pharaohs, Ramesses II led numerous military campaigns, taking armies into Syria to the east, Libya to the west, and Nubia in the far south. His main rival was the Hittite emperor, Mutawallis. The climax of his second Syrian campaign was the Battle of Kadesh in 1275BCE, a clash with the Hittites that involved large chariot forces on both sides. Ramesses survived a devastating charge by the Hittite chariots to emerge victorious.



▲ The head from a colossal statue of Ramesses II at the Temple of Abu Simbel, in southern Egypt.



▸ TUTANKHAMEN
The Egyptian pharaoh Tutankhamen (reigned 1332–1322 BCE) is depicted shooting volleys of arrows at his fleeing enemies. In reality, the king was a boy who would not have led his troops in battle.

KEY DEVELOPMENT

THE FIRST WARRIORS

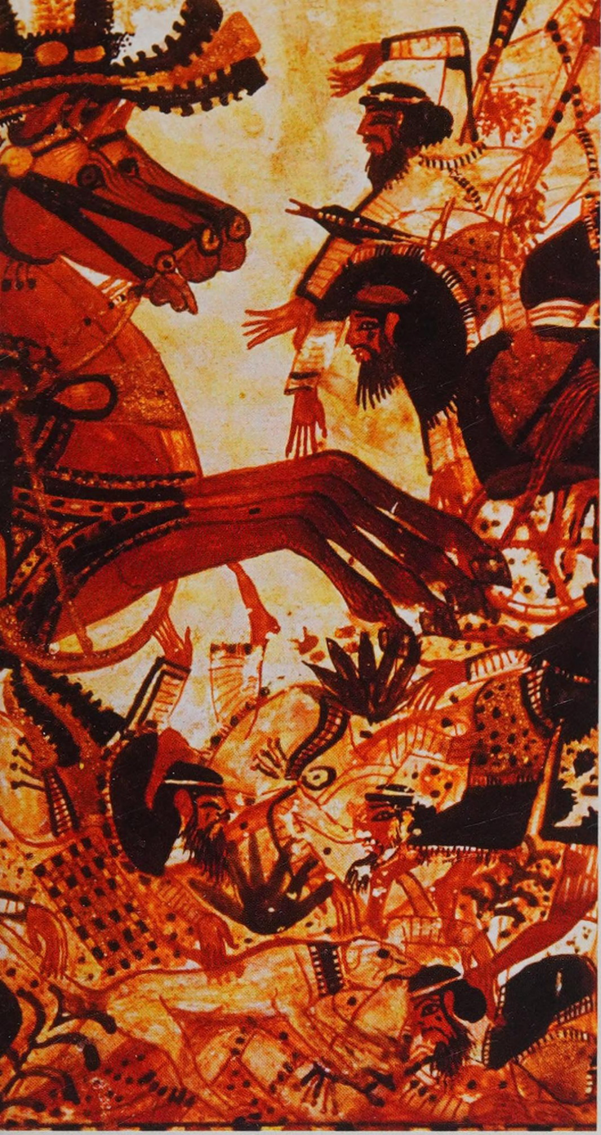
The birth of advanced civilizations in the Near East, around 3000BCE, heralded the emergence of organized military forces. Over the next 3,000 years, a series of technical developments led to advances in weaponry, which in turn shaped the development of military tactics.

While it is likely that there was conflict of some sort between groups of hunters before agriculture began, a permanent warrior class only arose with the first farming communities, which needed to protect their surpluses. The earliest agricultural societies built defenses (such as the walls of Jericho, in around 8000BCE) and adapted stone hunting weapons for use in battle, leading to the invention of weapons such as the mace. It was not until the rise of the city-states of Sumeria, however, in the late 4th millennium BCE, that true organized armies began to appear.

THE RACE FOR COPPER

The discovery of copper-refining methods around 4500BCE led to the manufacture of the first metallic weapons, and may also have set off competition between city-states for access to the copper mines of Anatolia. These two factors contributed to the endemic state of war between Sumerian city-states, such as Uruk, Ur, and Kish, during the 4th and 3rd millennia BCE. Sumerian soldiers fought largely on foot, armed with long spears and arranged in

▾ AN EGYPTIAN SPEAR
The thrusting spear was the main weapon of Egyptian infantrymen, particularly under the Old Kingdom (2686–2181BCE). Like many ancient armies, the Egyptians fought in phalanxes, which opponents found difficult to penetrate.



phalanxes—units comprising densely packed rows of troops. They were supported by cumbersome, four-wheeled battle-wagons drawn by onagers (a species related to the horse family).

The Akkadians overcame the Sumerians in around 2350BCE. Under a leader named Sargon, they established the first empire in the Near East, uniting the lands of many city states. Sargon was the first military leader to make use of archers on a large scale, giving the Akkadians a crucial advantage against their less versatile foes.

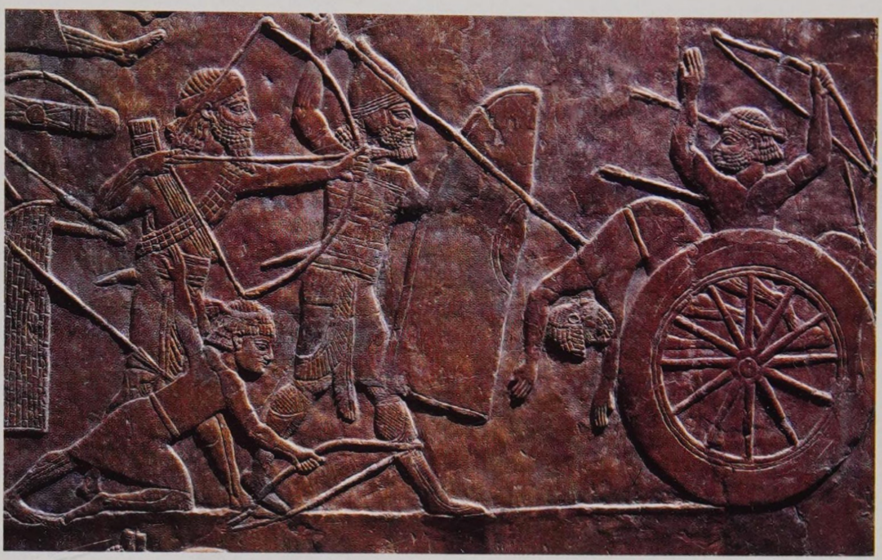
THE RISE OF BRONZE

In the second millenium BCE, two technical innovations occurred that would shape warfare in the ancient Near East for another thousand years. The first of these was the introduction of bronze. Emerging around 2800BCE, this alloy of copper and tin gave a more durable, sharper edge to weapons than copper alone. Until the technique of bronze-making became widely known, it was prohibitively expensive, but by around 1800BCE, bronze had replaced copper as the predominant metal used for armaments. At about the same time, horse-drawn chariots with two wheels also appeared, adding a new, highly mobile dimension to warfare.

From around 1300BCE, the Egyptian army—previously an almost entirely infantry force—was radically reorganized under the influence of the Hyksos, a group of foreign invaders who introduced chariots, bronze swords, and metal scale armor. This coincided with an era of Egyptian imperialism, when the armies of pharaohs such as Ramesses II expanded into the Levant and engaged in bitter struggles with rival kingdoms such as the Hittites.

THE AGE OF IRON

By around 1000BCE, iron, being stronger than bronze, was becoming the metal of choice for weapons. It was exploited to lethal effect by the Assyrians (see pp.20–21). During the reign of Tiglath-Pileser III (745–27BCE), Assyria established the world's first standing army, which, when boosted by drafting, numbered over 100,000 men. They wielded the longer swords that iron made possible, and were protected by knee-length metal tunics. Assyrian tactics combined the well-orchestrated push of a heavy phalanx of infantry, with supporting fire from archers and slingers, and assaults by auxiliary units of heavy cavalry and charioteers. With a clear chain of command and a reputation for ferocity and cruelty against their enemies, the Assyrian army was the most formidable fighting force the ancient world had yet produced.



▲ AN ASSYRIAN VICTORY
This relief of the Battle of Til Tuba (655BCE) shows the Assyrian archers and spearmen who drove their Elamite foes into the Ulai River, where thousands drowned. The Elamite ruler, Teumanni, was captured and executed.

KEY EVENTS

2600–750BCE

- **2600BCE** A Sumerian artifact known as the Standard of Ur provides the first depiction of an organized army, with mosaic scenes showing rows of infantry carrying spears and battle-axes, accompanied by onager-drawn battle-wagons. The infantry have no shields or armor.
- **2000BCE** The first metal swords appear in Mesopotamia as bronze-making spreads and the metal becomes cheaper to produce.
- **c.1300–1250BCE** New Kingdom Egypt undergoes its period of greatest expansion, while chariot warfare reaches its peak. The Hittite empire disintegrates, after which a period of disorder reigns in the Near East.
- **c.1000–750BCE** The introduction of iron weaponry aids the expansion of the Assyrian empire. Assyria is the dominant military power in the Near East by 750BCE.

> "**I tore down… their towns** and **set fire to them,** and turned them into **forgotten mounds**"
>
> **ASSYRIAN RULER SENNACHERIB**, ON A REVOLT BY THE CHALDAEANS, 703BCE

STONE AND BONE WEAPONS

The first human tools were made of stone, bone, or wood. The earliest were simple pebble choppers and scrapers, but by around 1.75 million years ago, these had developed into the first hand axes—shaped blades—that could be gripped firmly in the hand to strike an enemy. Gradually, the blades became narrower and sharper, most often made of flint, a stone that was hard but could be easily shaped. Wooden shafts were bound to sharp blades to form axes and spears, and eventually—with the invention of the bow—to act as arrowheads, vastly extending the range at which the warrior could attack. Most early stone weapons were made with multiple uses in mind, from domestic tasks to hunting, as well as warfare.

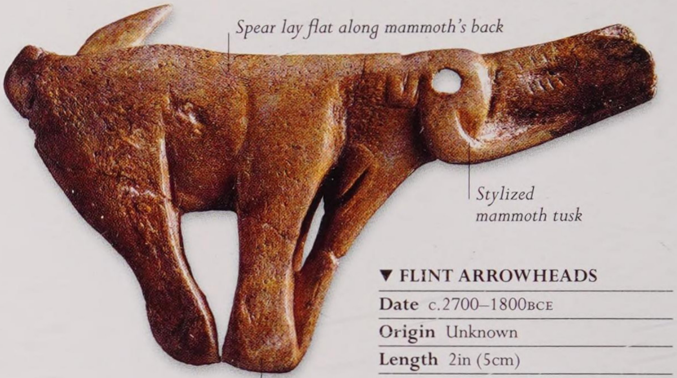
▼ ATLATL

Date c.10,500BCE

Origin France

Length Unknown

Atlatls, or spear throwers, were developed around 20,000 years ago. They increased a spear's velocity and range, which allowed the bearer to kill prey from a greater distance. This reindeer-ivory example is carved as a mammoth.


Spear lay flat along mammoth's back

Stylized mammoth tusk

Handle in shape of mammoth legs

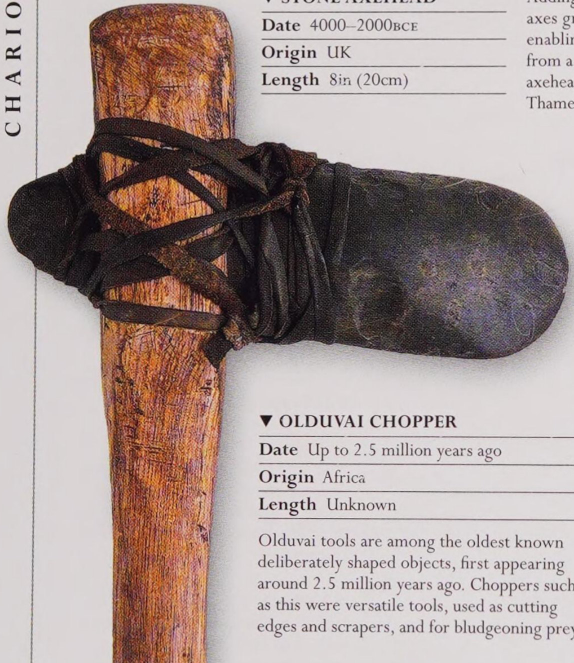
▼ STONE AXEHEAD

Date 4000–2000BCE

Origin UK

Length 8in (20cm)

Adding wooden handles gave axes greater reach and power, enabling the bearer to attack from a safer distance. This stone axehead was dredged from the Thames River in London.



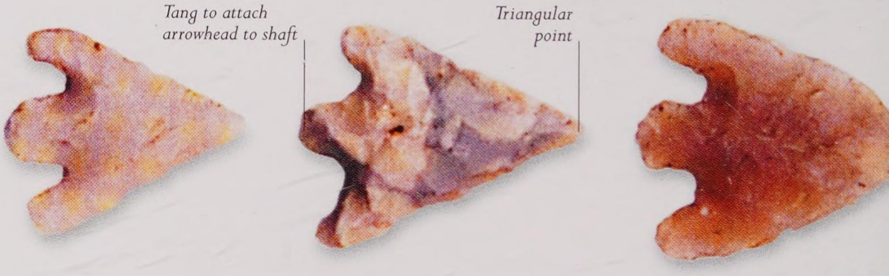
▼ FLINT ARROWHEADS

Date c.2700–1800BCE

Origin Unknown

Length 2in (5cm)

The invention of the bow during the Paleolithic period made it possible to shoot projectiles at great range and with accuracy. Because these flint arrowheads were barbed, they embedded themselves deep in the victim's flesh.


Tang to attach arrowhead to shaft

Triangular point

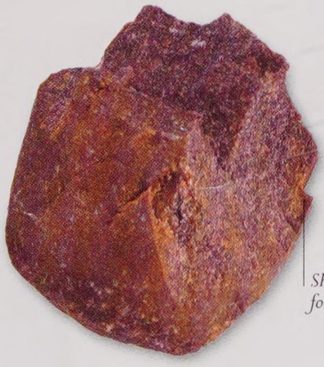
▼ OLDUVAI CHOPPER

Date Up to 2.5 million years ago

Origin Africa

Length Unknown

Olduvai tools are among the oldest known deliberately shaped objects, first appearing around 2.5 million years ago. Choppers such as this were versatile tools, used as cutting edges and scrapers, and for bludgeoning prey.


Sharp edge for cutting

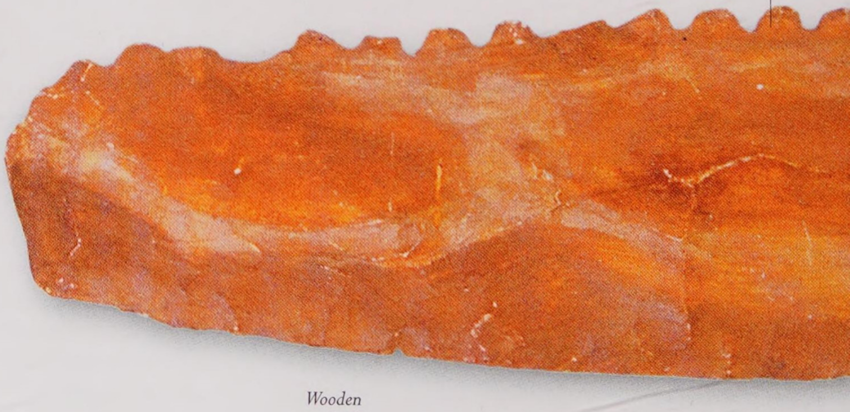
▼ SERRATED FLINT KNIFE

Date 1,500,000–10,000BCE

Origin Unknown

Length 8in (20cm)

Serrated edges were developed for sawing through bone or other tough materials. However, the jagged flint edges on this knife could also inflict savage cuts.


Serrated teeth for sawing

► FLINT HAND DAGGER

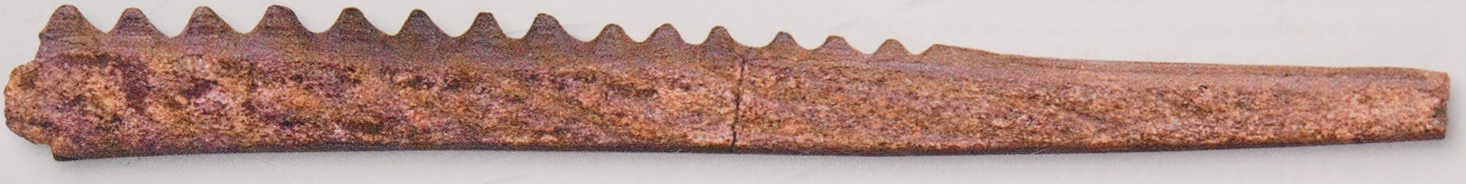
Date c.2000BCE

Origin Unknown

Length 12in (30cm)

The addition of wooden shafts to flint blades, bound with sinew or leather strips, created stabbing spears, and allowed the bearer to use the full force of his arm to strike blows.

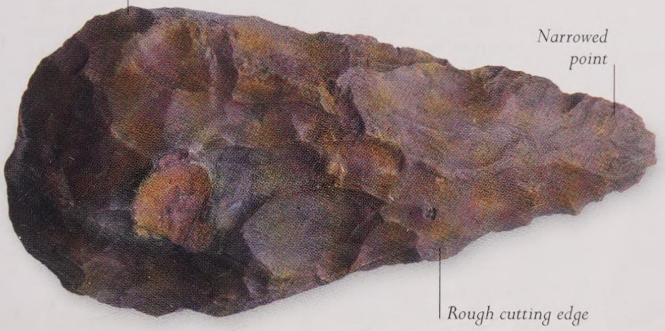
Wooden shaft



▲ BONE HARPOON

Date c.28,000–13,000BCE
Origin Unknown
Length Unknown

Stone Age hunters did not use just stone for their weapons. From toward the end of the last Ice Age, 30,000–15,000 years ago, many weapons of bone survive, such as this harpoon, which might have been used for spearfishing.



Broad end for handgrip

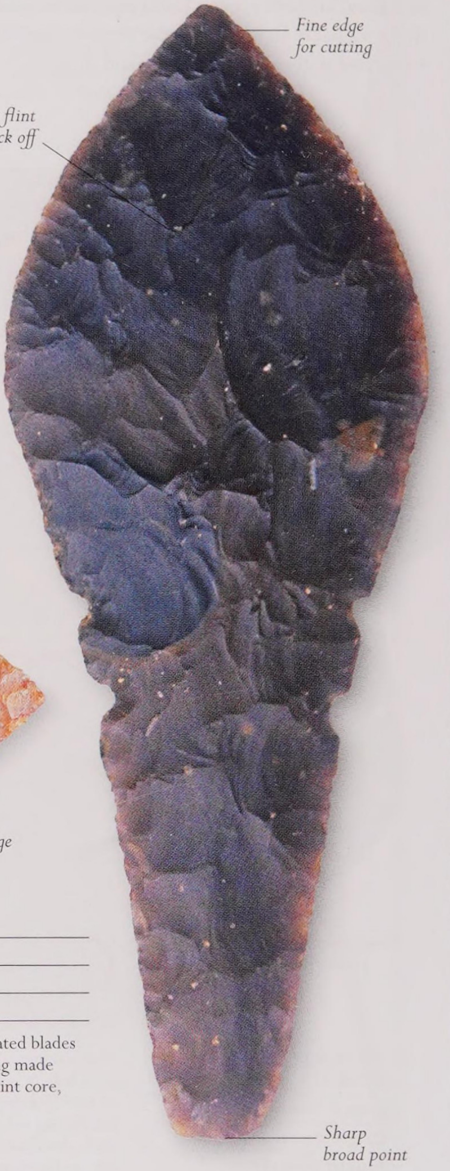
Narrowed point

Rough cutting edge

◀ HAND AX

Date 250,000–70,000BCE
Origin Unknown
Length 6in (15cm)

The first hand-held weapons, hand axes were essentially small rocks shaped to form a handgrip and blade. They were useful both as domestic tools and for attacking enemies.



Fine edge for cutting

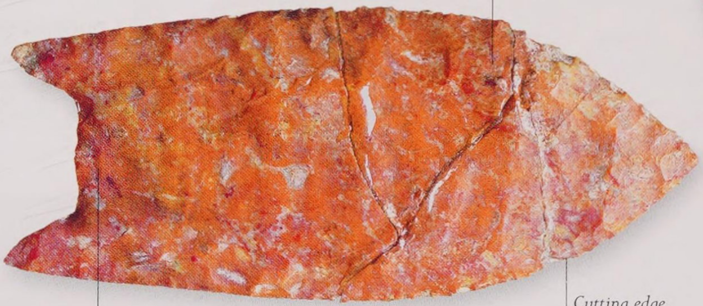
Indentations where flint flakes were struck off

Sharp broad point

▶ SMALL CLOVIS POINT

Date c.10,000BCE
Origin North America
Length 4in (10cm)

Clovis points were made by alternately flaking off pieces from both sides of the core, creating fluted edges. They were a characteristic feature of the weapons used by settlers in North America from around 15,000 years ago. Clovis points were replaced by shorter and thinner Folsom points 8,000 years ago.



Fluted groove caused by striking off flakes

Cutting edge

Originally attached to shaft

Leather or sinew binding

Pointed flint blade

▶ FLINT DAGGER HEAD

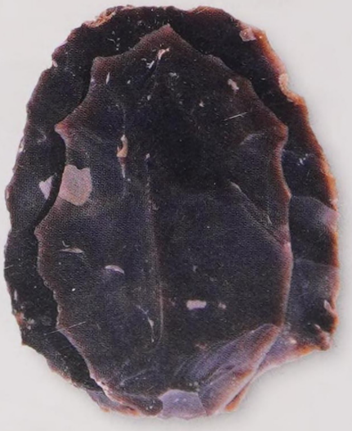
Date c.2000BCE
Origin Unknown
Length 6in (15cm)

By the Neolithic period, sophisticated blades such as this dagger head were being made by striking off flakes from a hard flint core, producing a sharp, flat blade.

▶ LEVALLOIS FLAKE POINT

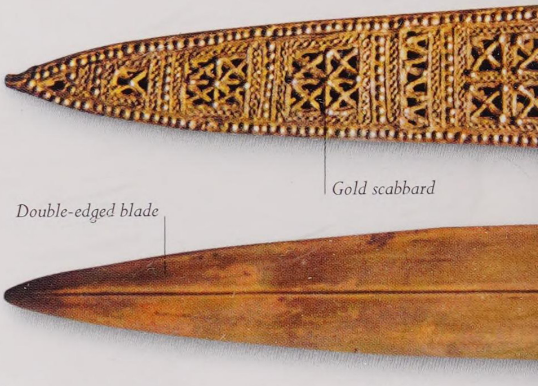
Date Post-300,000BCE
Origin Unknown
Length Unknown

The Levallois point was made by flaking off points from a central flint core to create the pattern of the desired shape, which was then struck off to create the final object. It had a characteristic scarring pattern on its surface.



EARLY METAL WEAPONS

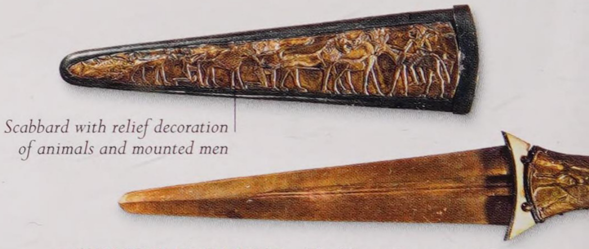
The first organized armies, those of the Sumerians, are recorded in around 3000BCE. While heavy war wagons were used, the Sumerians fought largely on foot and carried spears and shields. The development of the spoked wheel enabled much lighter, faster vehicles to be built—open chariots, from which archers could shower enemies with arrows. Thus, chariot warfare came to dominate conflict in the Near East in the second millennium BCE. But as advances in horse breeding produced more robust animals, mounted archers—even faster and more maneuverable than chariots—became more valuable to armies in the region, together with infantry foot soldiers equipped with spears, swords, and daggers.



▲ SUMERIAN DAGGER

Date	c.2500BCE
Origin	Sumeria
Length	8–12in (20–30cm)

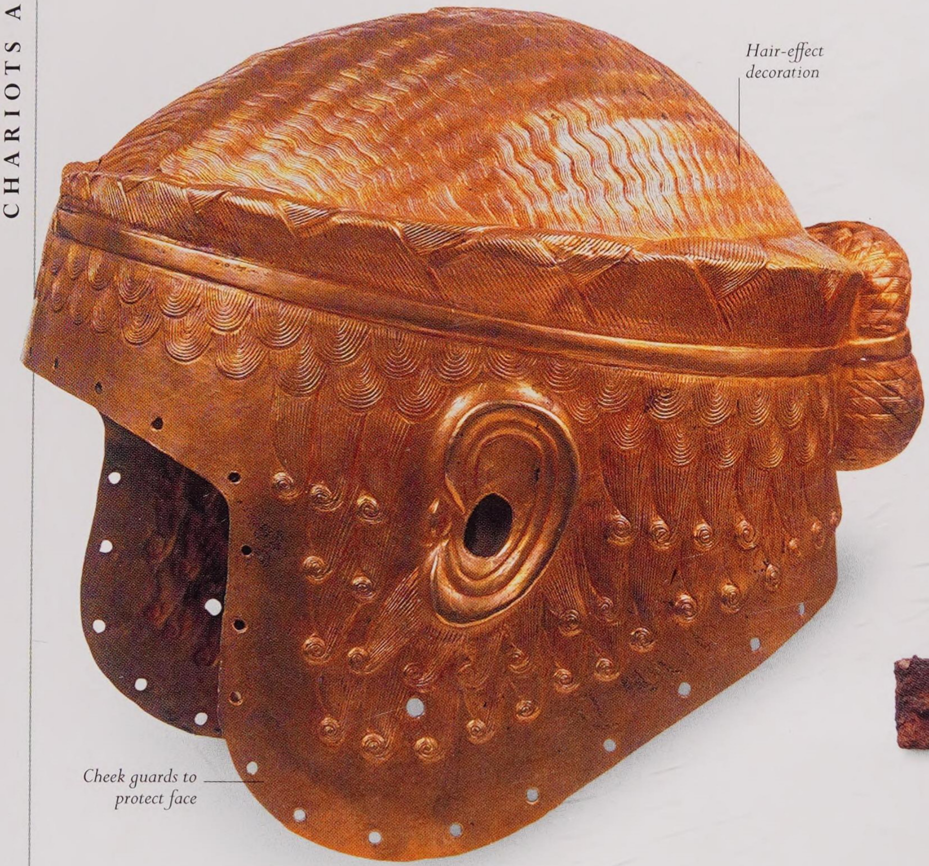
This ornate ceremonial dagger was excavated from the tomb of Queen Pu-Abi at Ur. Its blade and scabbard are crafted in gold, while the hilt is made from lapis lazuli trimmed in gold.



▲ PHOENICIAN DAGGER

Date	18th century BCE
Origin	Phoenicia
Length	15¾in (39.3cm)

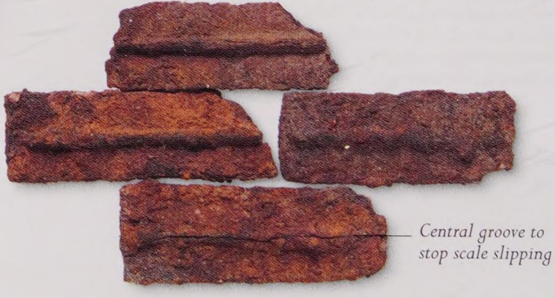
The Phoenicians occupied trading cities of the Levantine coast and were known more as merchants than as warriors. This magnificent gold and ivory dagger and scabbard signified the bearer's wealth and were not intended for military use.



▲ HELMET OF MESKALAMDUG

Date	c.2500BCE
Origin	Sumeria
Length	8½in (22cm)
Material	Gold, silver

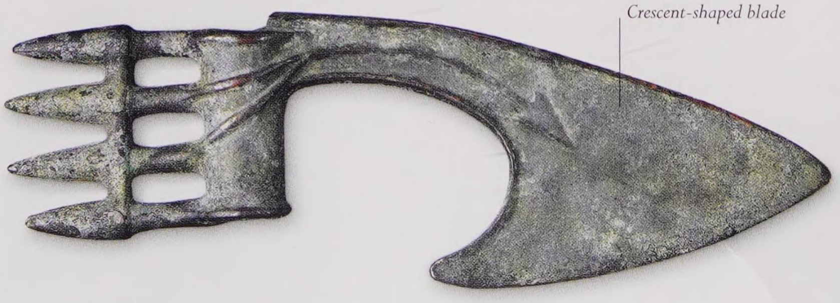
This ceremonial, gold-and-silver alloy helmet was found in the tomb of Meskalamdug at Ur in Sumeria. It is known as a wig helmet because of the intricately carved imitation of hair on the crown.



▲ ASSYRIAN SCALE ARMOR

Date	1800–620BCE
Origin	Assyria
Length	2in (5cm)

Assyrian soldiers wore a *sariam*, a long coat made of lamellar armor. Bronze scales, such as these, were laced together through holes punched in the side. A complete set of armor consisted of up to 1,000 scales, weighing 33–55lb (15–25kg).

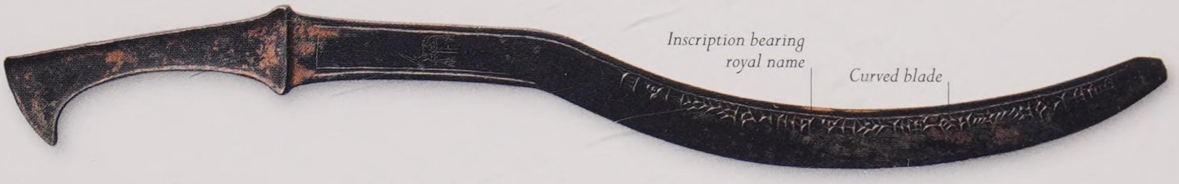


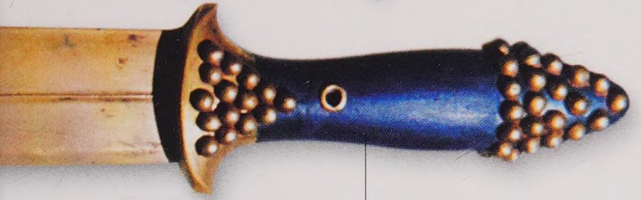
◄ PERSIAN BRONZE AXEHEAD

Date	10th–7th century BCE
Origin	Persia
Length	8in (20.5cm)

The blade on this spike-butted ax is set at an angle, which would have been impractical in combat, suggesting that the ax was for ceremonial use.

Double-edged blade


Inscription bearing royal name
Curved blade


Blue lapis lazuli hilt

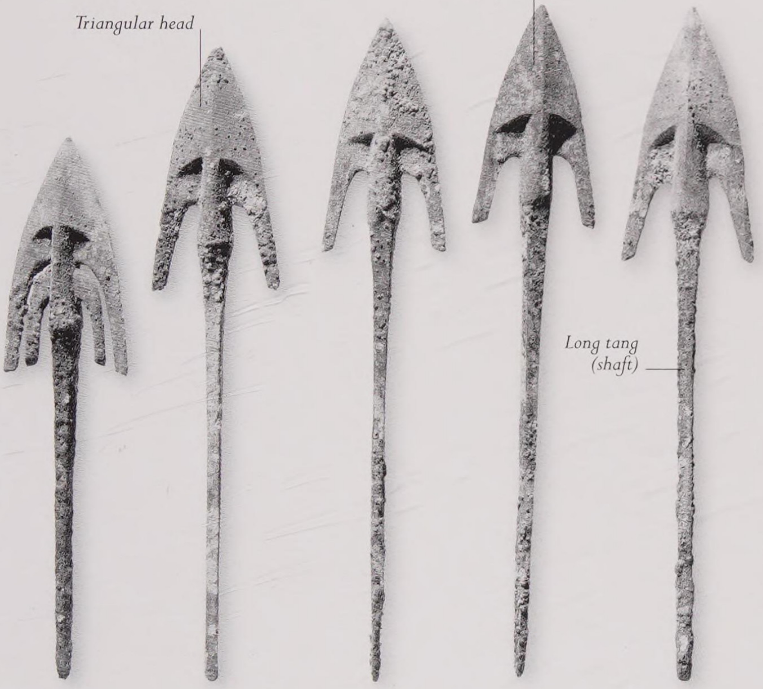
▲ ASSYRIAN SAPPARA

Date c.1300BCE

Origin Assyria

Length 20¼in (51.3cm)

The *sappara*, or sickle-sword, was a characteristic weapon of the Assyrian foot soldier. This one has a cuneiform inscription, indicating that it may have belonged to the Assyrian ruler Adad-nirari I (r.1307–1275BCE).


Triangular head
Raised groove
Long tang (shaft)

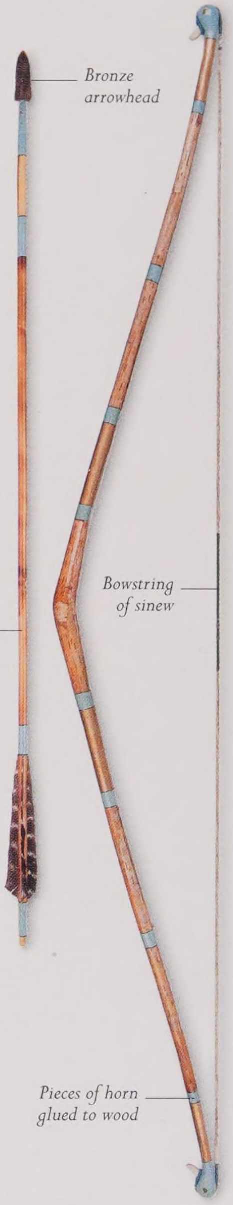
◀ CAUCASIAN ARROWHEADS

Date c.1000BCE

Origin Southern Caucasus

Length Up to 6¾in (17.1cm)

Large numbers of cast-bronze arrowheads have been excavated in the southern Caucasus. They suggest that the armies of the peoples of this area, to the north of Assyria, relied heavily on archers.


Bronze arrowhead
Bowstring of sinew
Cane shaft
Pieces of horn glued to wood

▶ ASSYRIAN BOW AND ARROW

Date c.750BCE

Origin Assyria

Length (Bow) 4¾ft (1.42m)

Archers formed the main part of the Assyrian infantry. They operated in pairs—one man acting as a shield-bearer, while the other used a bow, such as this one, a replica made from horn, sinew, and wood.

▶ ASSYRIAN ARROWHEADS

Date c.700BCE

Origin Assyria

Length 1in (3cm)

These heavily corroded iron arrowheads were found at the Judaean town of Lachish, captured by the Assyrians after a brutal siege in 701BCE. Assyrian bows could have a range of more than 820ft (250m).

◀ PERSIAN AKINAKES

Date 550–350BCE

Origin Persia

Length 13½in (34cm)

Along with spears, infantrymen also carried *akinakes*—a short, thrusting sword used for close-quarter combat—worn on their right side. High officials are frequently depicted wearing them in Persian art.

THE SIEGE OF LACHISH

By the 8th century BCE, the Assyrian empire had an army of unprecedented size and efficiency. Its assault on the fortified town of Lachish, recorded in reliefs in the Assyrian palace in Nineveh, demonstrated sophisticated, if well-established, siege techniques and the calculated use of terror.

The army that King Sennacherib led to Judah in 701BCE comprised a mixture of foot soldiers and mounted troops on chariots or on horseback. There was also a dedicated body of engineers, skilled in building earthworks and siege machines. The army's mission was to crush a revolt by the Judean King Hezekiah, and to impose exemplary punishment to deter any further resistance to Assyrian imperial rule.

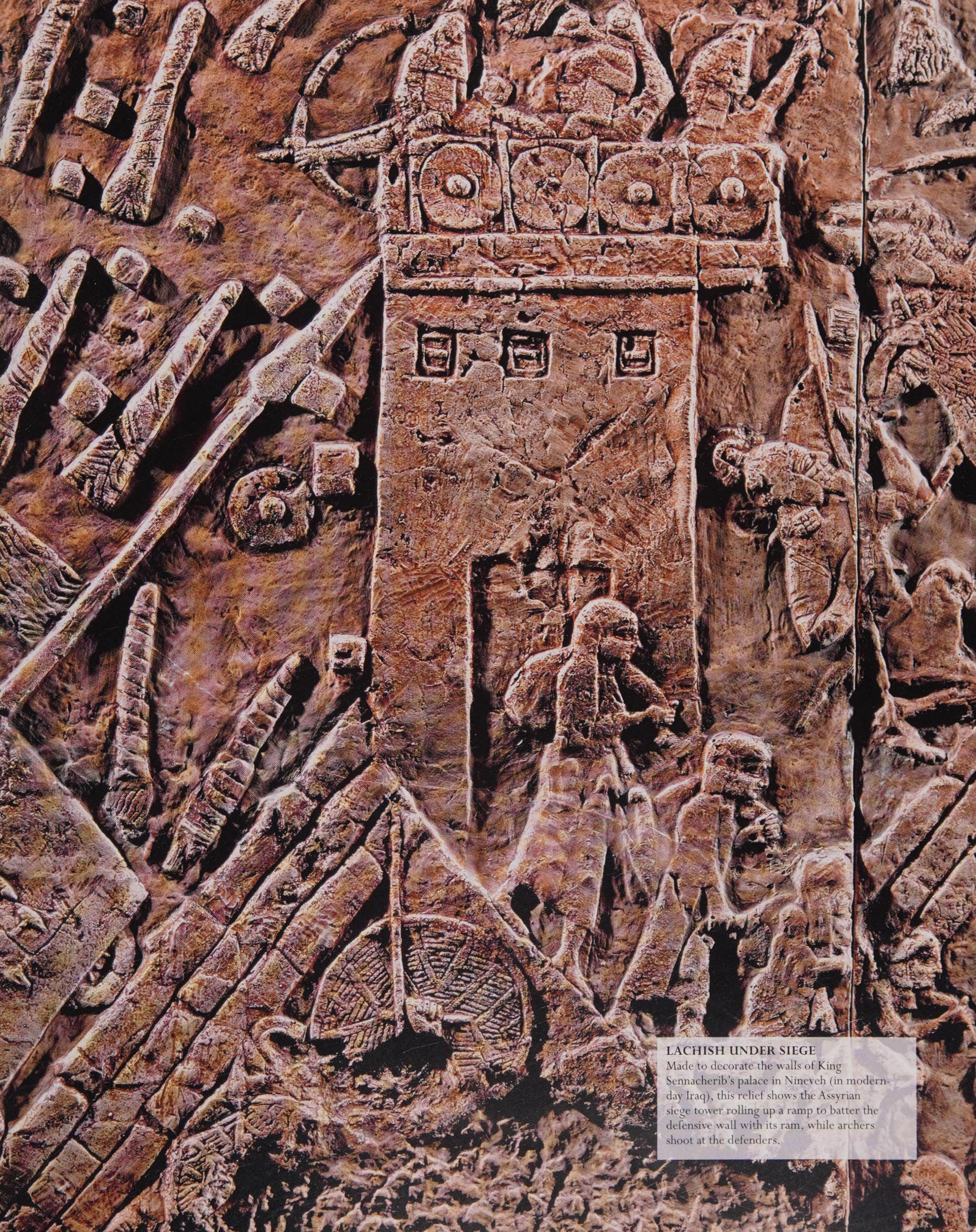
The Assyrians' principal missile weapon was the composite bow. Capable of shooting an iron-tipped arrow to an effective range of over 820ft (250m), it was used by charioteers and horsemen, as well as by troops on foot. Assyrian foot soldiers also employed slingshots, flinging shaped stones a distance of 330ft (100m). Both of these were deadly anti-personnel weapons, and during a siege arrows could be turned into incendiary devices by dousing their tips in flammable pitch. Neither arrows nor small stones posed any threat to the high mud walls of Lachish, however, which presented a formidable challenge, even to an armed force that must have far outnumbered the defenders.

To force entry into a walled town, the Assyrian troops had to advance to the walls and find ways either to breach them or go over them. Assyrian engineers had developed a range of techniques for assailing fortifications. They could attack the foundations, digging at the base of the walls to undermine them; they could build a ramp against a wall or tower, allowing troops a route to the summit of the battlements; they could attack the walls with siege towers and metal-tipped battering rams. Or, more simply, troops armed with spears and swords could be sent forward with ladders to scale the walls or fortifications.

SIEGE TOWER AND INFANTRY

At Lachish, engineers built a ramp of rocks and earth reaching to a point halfway up the fortifications. At the same time they assembled a large siege tower, with a ram in its lower story. Mounted on four wheels, the wooden tower was covered in hides and canvas. When the Assyrians were ready to attack, they manhandled the tower and ram up the ramp. While archers in the tower's upper story shot at the defenders, soldiers battered the ram against the exposed wall. The defenders fought back against the assault, throwing rocks and flaming torches onto the tower, but the Assyrian soldiers kept water-filled buckets in the tower for extinguishing the resulting fires. Meanwhile, tightknit groups of soldiers on foot launched a secondary assault on the walls, armed with spears and protected by shields and armor. Assyrian bowmen supported this advance with a barrage of arrows directed at the defenders on the walls, each bowman sheltered by a curved reed screen held by his shield-bearer.

The exact sequence of events leading to the fall of the town is not known, only that the Assyrians overcame the town's defenses. The aftermath of this victory, depicted in reliefs for the king's enjoyment, involved the cruel execution of a large number of Judeans and the exile of the survivors.



LACHISH UNDER SIEGE
Made to decorate the walls of King Sennacherib's palace in Nineveh (in modern-day Iraq), this relief shows the Assyrian siege tower rolling up a ramp to batter the defensive wall with its ram, while archers shoot at the defenders.

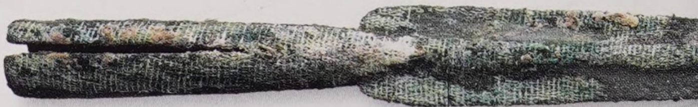
ANCIENT EGYPTIAN WEAPONRY

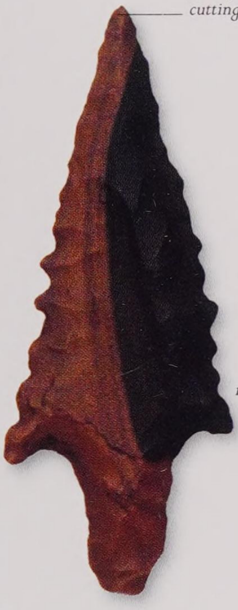
Egyptian soldiers were mainly peasant conscripts who fought almost exclusively on foot until around 1500BCE. The archers were the most important component of the army, and they carried light bows with a range of about 165ft (50m). The other infantry, known as the *nakhtu-aa* ("strong-armed"), fought in close formation using battle-axes and spears. Both types of warrior also carried a dagger in a leather scabbard, which was often strapped to the lower arm. For protection, the archers relied on a leather kilt, while the infantry carried a large, wooden-framed shield covered with cowhide. After the beginning of the New Kingdom in around 1550BCE, the Egyptian army began to use chariots, which were utilized by archers as a mobile platform from which to fire.

▼ BRONZE SPEARHEAD

Date	c.2000BCE
Origin	Egypt
Length	10in (25cm)

Egyptian infantrymen were usually equipped with a spear, which was generally used for thrusting rather than throwing. Before around 1500BCE, the blade was lashed to the haft rather than inserted into a socket.

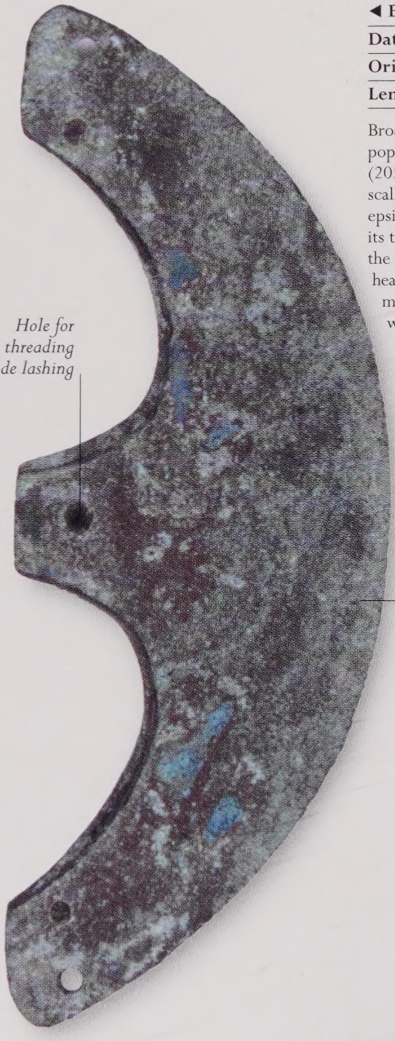




▲ FLINT ARROWHEAD

Date	5500–3100BCE
Origin	Egypt
Weight	¼oz (2–2.5g)
Length	2¼in (6.1cm)

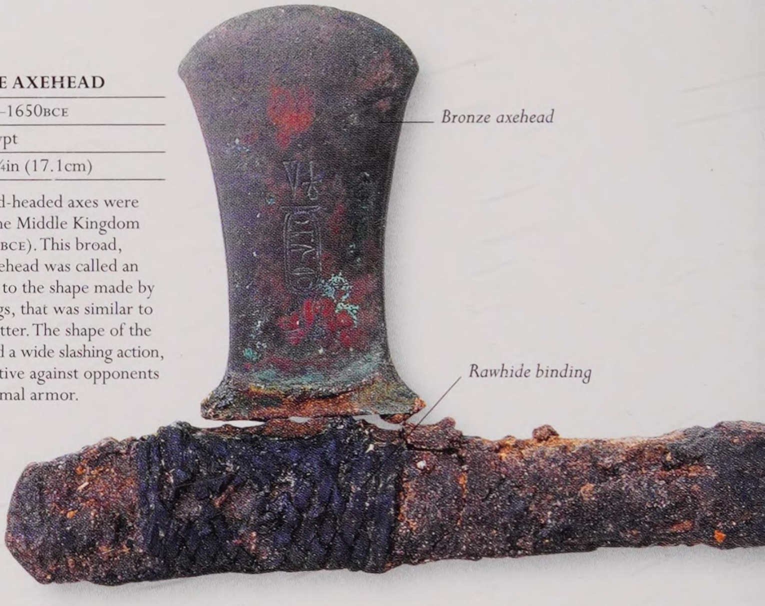
Archers formed a crucial component of Egyptian armies. They carried a simple bow, around 5ft (1.5m) long, made of acacia wood. The arrowheads were made of bone, flint, ebony, or copper, with triangular or barbed ends.


Hole for threading rawhide lashing
Wide half-moon shaped head

◀ BRONZE AXEHEAD

Date	2055–1650BCE
Origin	Egypt
Length	6¾in (17.1cm)

Broad, round-headed axes were popular in the Middle Kingdom (2055–1650BCE). This broad, scalloped axehead was called an epsilon, due to the shape made by its three tangs, that was similar to the Greek letter. The shape of the head allowed a wide slashing action, most effective against opponents with minimal armor.



▲ BATTLE-AX

Date	1630–1520BCE
Origin	Egypt
Length	16¼in (41.1cm)

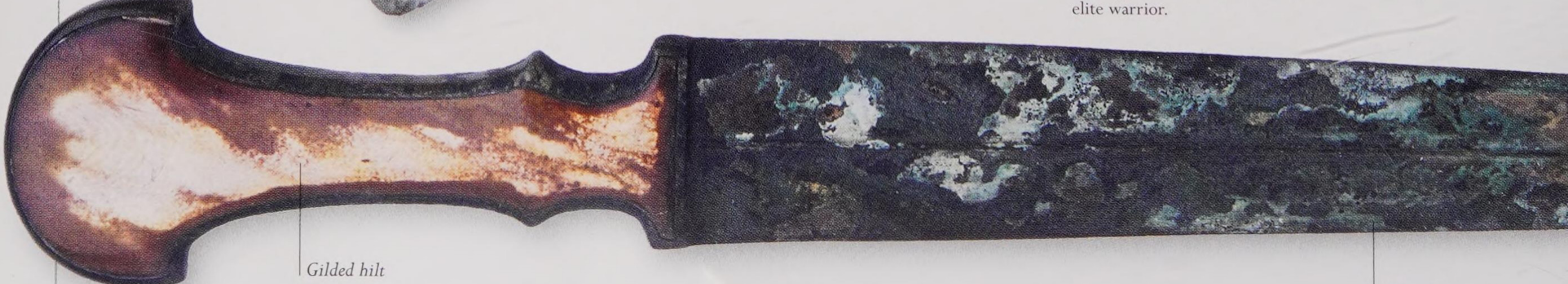
Egyptian axes typically had a heavy, bronze, D-shaped head. This axehead was attached to the haft with wet rawhide thongs to ensure a stronger fit. The hafts were generally wider at the base, which was wrapped in linen to provide a stronger grip.

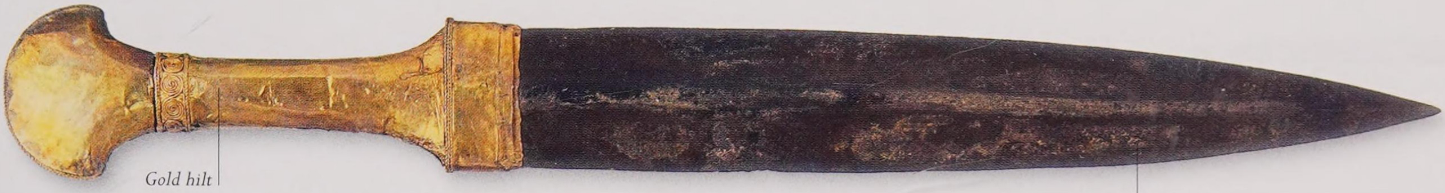
Falcon on the underside of the pommel

▼ LONG SWORD

Date	1539–1075BCE
Origin	Egypt
Length	16in (40.6cm)

This double-edged copper sword, worn on a belt around the soldier's waist, dates from the New Kingdom. Its straight blade made it more suitable for thrusting than slashing. The gold hilt suggests it was crafted for an elite warrior.



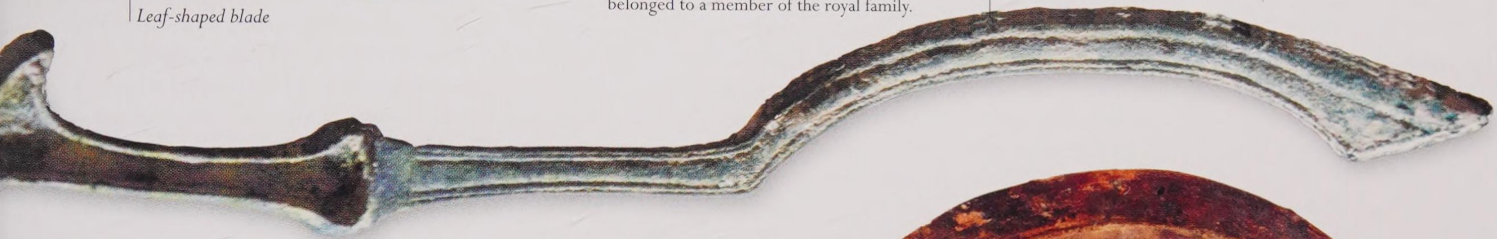


▲ SHORT SWORD

Date	1539–1075BCE
Origin	Egypt
Length	12¾in (32.3cm)

Swords were probably introduced in the New Kingdom by invaders from the eastern Mediterranean, known as the "Sea Peoples." This broad-bladed short sword is a display weapon that probably belonged to a member of the royal family.

Leaf-shaped blade



▲ SICKLE SWORD

Date	1200–1000BCE
Origin	Egypt
Length	23½in (60cm)

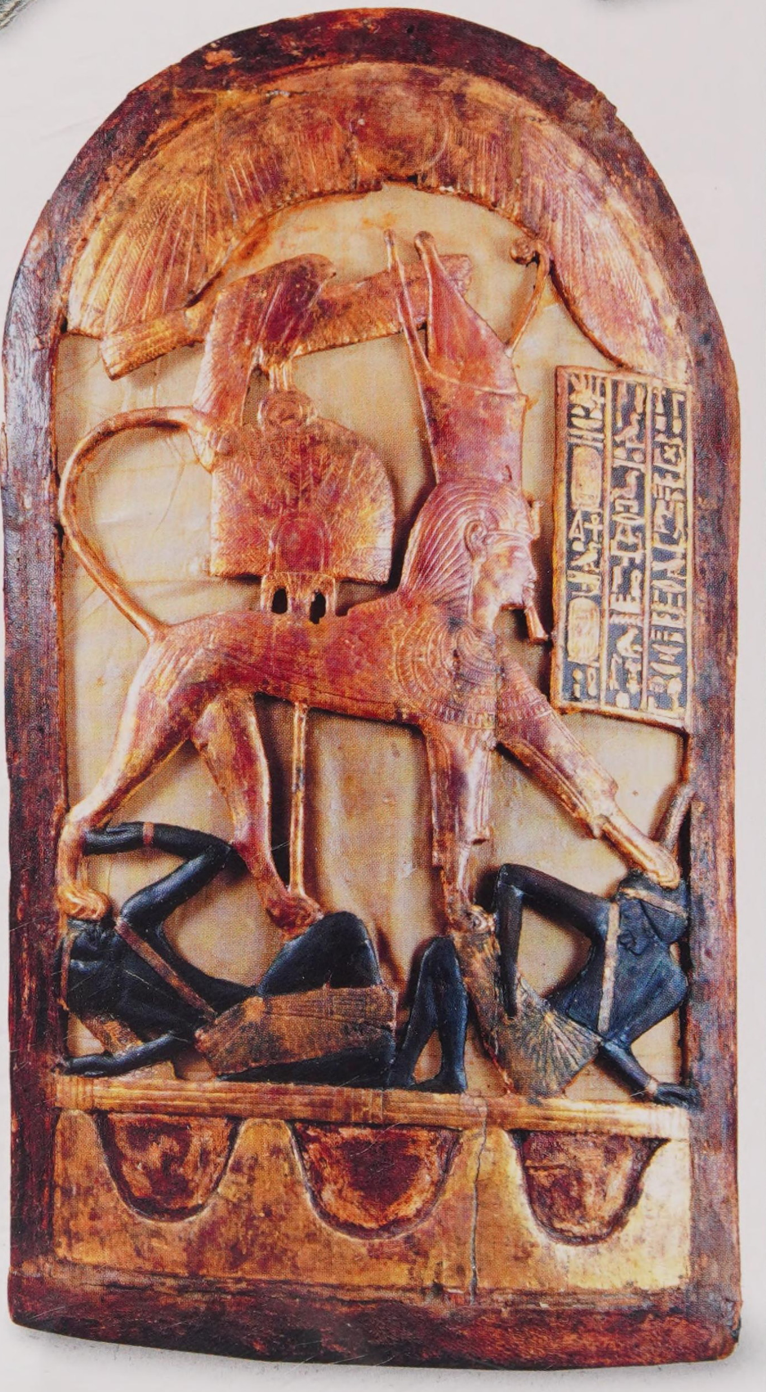
The *khepesh*, or sickle-sword, came into use at the start of the New Kingdom. The curved blade had its cutting edge around the outside. The weapon was wielded more like an ax than a sword, and heavier specimens could be used to rip an opponent's armor open, leaving him vulnerable to blade thrusts.

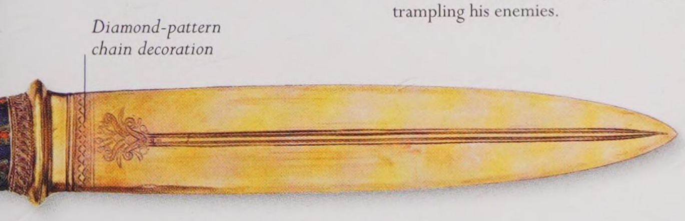
Wooden haft

▶ LION SHIELD

Date	c.1325BCE
Origin	Egypt
Width	21¼in (54cm)

The soldier's shield had a slightly convex shape. This protected the sides of his body and helped him push against a densely packed line of opponents. This ornate display shield from the tomb of Tutankhamen shows the Pharaoh in the shape of a sphinx trampling his enemies.





▲ PHARAOH'S DAGGER

Date	c.1325BCE
Origin	Egypt
Length	12½in (31.9cm)

This dagger was found with the mummy of Tutankhamen and, with its golden blade and ornate golden sheath, was intended strictly for ceremonial use. The falcon on the hilt symbolized protection for the Pharaoh in the afterlife.

KEY DEVELOPMENT

HOPLITES AND PHALANXES

Around 700BCE, a new type of foot soldier emerged in Greece. The hoplite, equipped with a long spear, a sword, an elaborate bronze corselet and helmet, and a large wooden shield (*aspis*, or *hoplon*), would form the backbone of Greek armies for the next 500 years.

The earliest examples of hoplite equipment date back to about 710BCE, and within half a century of this date, depictions on vases show hoplites fighting in their signature tactical formation – the phalanx. Composed of rows of spear-wielding hoplites, the phalanx was normally eight men deep. With spears of around 240–70cm (95–105in) in length, only the first three ranks could reach the enemy line, but the phalanx's structure presented a fearsome barrier.

THE AGE OF THE HOPLITE

In the 7th and 6th centuries BCE, the main hoplite tactic involved colliding with the opposing phalanx, followed by concerted pushing and stabbing. There was little tactical sophistication, and the encounters continued until one side broke and fled. Only the hoplite's left side was fully protected, thanks to the *hoplon* (shield) of the man next to him: as a result, the phalanx tended to drift to the right, as each man tried to edge behind the *hoplon* of his neighbour.

By the early 5th century, bronze corselets had been superseded by linen or scale leather armour, allowing the wearer more freedom of movement. When Darius of Persia invaded Greece in 490BCE, the lightly armed Greek phalanx charged the Persian archers at Marathon, neutralizing one of their opponents' key advantages, and aiding an unlikely Greek victory against significant odds. Eleven years later, at Plataea, a renewed Persian invasion was defeated by the hoplites of Sparta, a militarized Greek city-state that trained its warriors from childhood. Sparta's rival, Athens, also participated in the land campaign against the Persians, but its most valuable contribution was a fleet of triremes – fast ships powered by triple banks of oarsmen – that outmanoeuvred the Persians to victory at Salamis, in 480BCE.

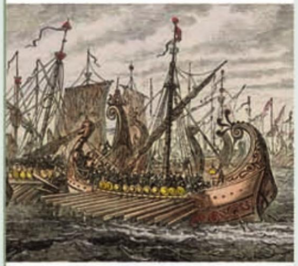
With the Persians defeated, Sparta and Athens clashed for almost the next 80 years, resulting in the Peloponnesian War (431–404BCE), which, though bloody, showed only a few innovations in equipment and tactics. The armies began to make more use of archers, and employed flexible light infantry, called peltasts, as skirmishers, armed with

KEY **BATTLE**

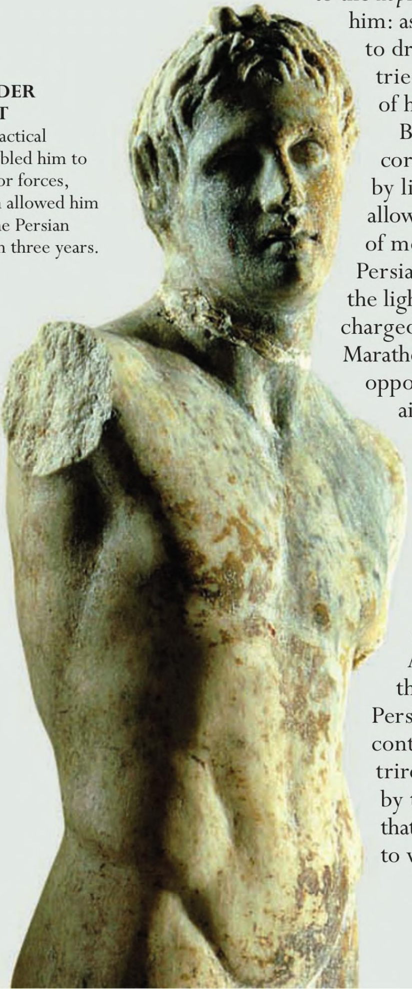
SALAMIS

480BCE

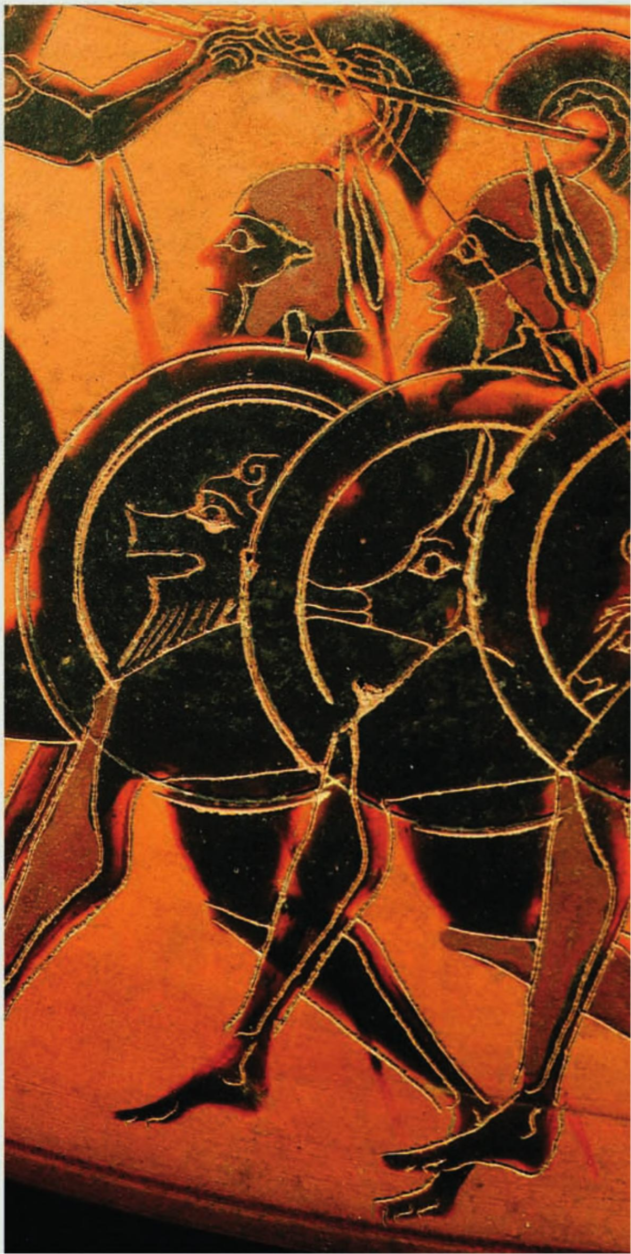
During the second Persian invasion of Greece, Athenian admiral Themistocles tricked Xerxes's Persian flotilla – three times the size of Themistocles' force of 378 triremes – into entering the Straits of Salamis. In the narrow waterway, the Persian force could not exercise its numerical advantage, and was badly mauled by the Greek ships.



▲ The Greek navy triumphed at Salamis through ingenious use of the terrain and waterways.



▶ **ALEXANDER THE GREAT**
Alexander's tactical brilliance enabled him to defeat superior forces, which in turn allowed him to conquer the Persian empire within three years.



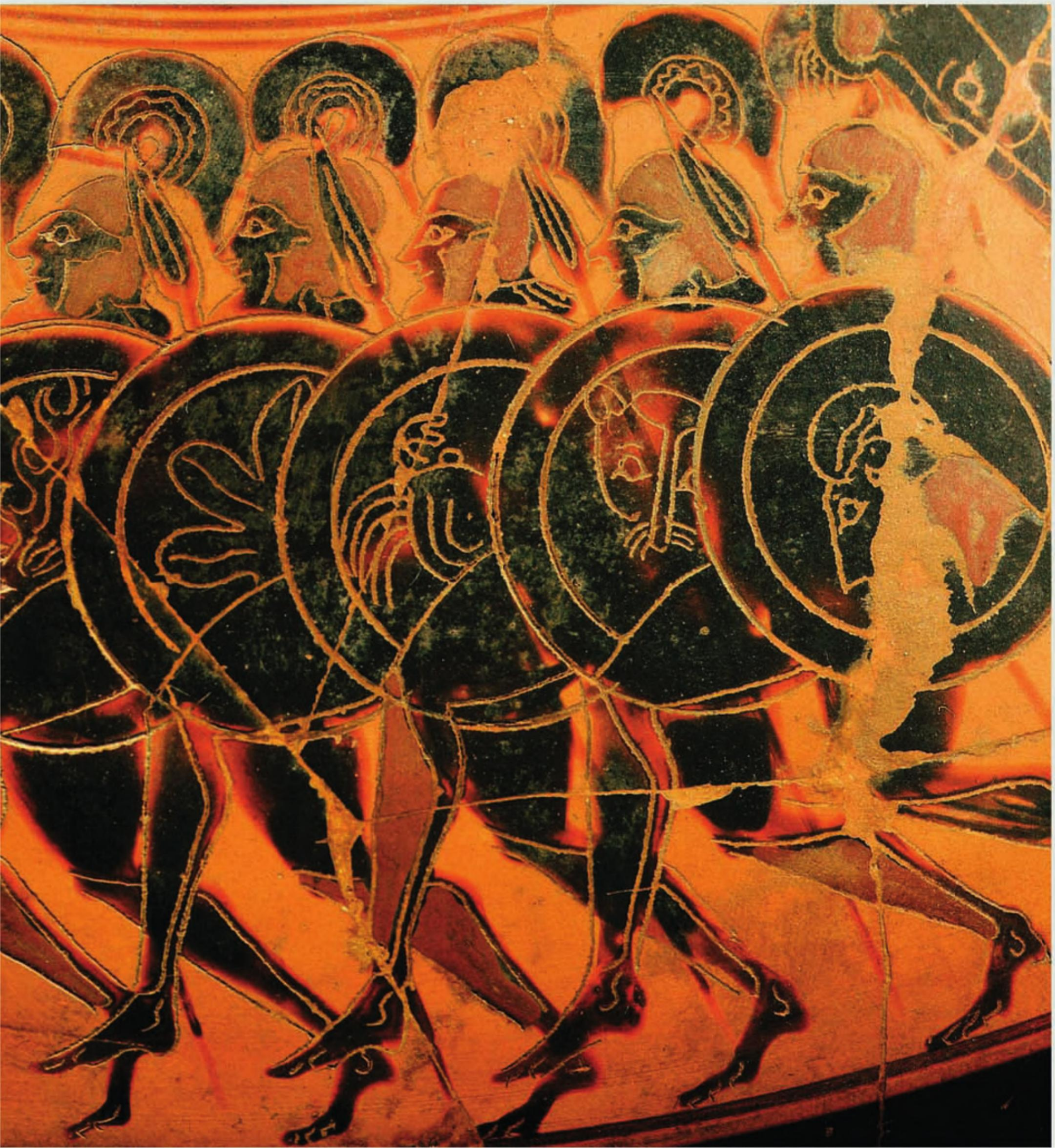
javelins and swords. However, almost as soon as Sparta emerged victorious in 404BCE, its power was challenged by the Thebans, led by Epaminondas.

THE EVOLUTION OF THE PHALANX

The Thebans deepened their phalanxes to 12 ranks or more, made greater use of cavalry, and trained an elite force known as the Sacred Band. This helped them win a stunning victory at Leuctra, in 371BCE, which broke Spartan supremacy. However, Theban dominance was short-lived and Greece fell into civil wars, ending with the rise of Macedon, first under Philip II and then Alexander the Great.

The Macedonians further deepened the phalanx to 16 ranks, and their soldiers carried the *sarissa*, a longer spear of up to 6m (20 feet), which allowed the first five rows to strike at the enemy. These armoured "phalangites" kept enemy infantry pinned down, while heavy cavalry, slingers, and peltasts launched their attack.

> "Like some **ferocious beast** as it turns at bay and **stiffens its bristles**"
>
> **PLUTARCH**, DESCRIBING THE APPEARANCE OF A PHALANX, c.100CE



◄ A HOPLITE CHARGE
This vase shows Greek hoplites running into battle, their Corinthian helmets, horsehair crests, bronze greaves, and spears clearly visible. The artist has not depicted the other ranks in the phalanx, which made it even more intimidating to behold.

KEY **EVENTS**

725–300BCE

- **c.725–700BCE** The earliest known war between Greek city-states (the Lelantine War between Chalcis and Eretria) is thought to have been fought in this period. Hoplite armour is also thought to originate in this era.

- **c.650BCE** The earliest depiction of hoplites in art shows them without swords, but carrying two spears: one for thrusting and one for throwing.

- **492–90BCE** The first Greco-Persian War takes place. Darius I of Persia invades Greece, attracting some allies in the north, but is defeated by the Athenians and their Plataean allies at the Battle of Marathon (490BCE), in which the Plataean hoplites surprise the Persians by charging into their ranks.

- **431–04BCE** Spartan and Athenian forces clash in the Peloponnesian War.

- **480BCE** Xerxes launches the second Persian invasion of Greece. The Persians are delayed by Spartan resistance at Thermopylae (480BCE). They are then defeated at Salamis (480BCE) by the Athenian navy, and at Plataea (479BCE), where Spartan hoplites break through the Persian line, causing the Persian army to flee.

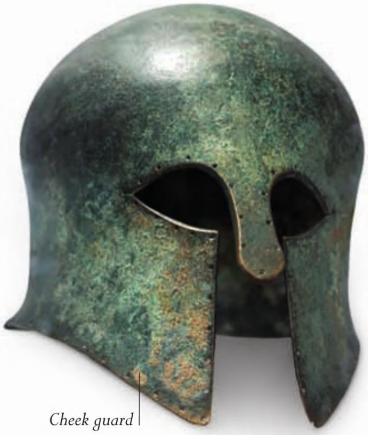
- **378BCE** The Thebans, under Epaminondas, destroy the Spartan army at the Battle of Leuctra, marking the beginning of the eclipse of traditional hoplite forces.

- **338BCE** At Chaeronea, Philip II of Macedon defeats the Thebans by feigning a withdrawal, stretching one wing of the Theban army in pursuit. Philip's son, Alexander, then charges the enemy's left wing with cavalry, routing it. The Theban Sacred Band is destroyed.

- **331BCE** The Battle of Gaugamela takes place. A Macedonian attack on the left wing of the Persian army, opens up a gap in their ranks, into which Alexander advances. This flexible approach is far in advance of traditional hoplite tactics.

HOPLITE ARMOUR AND WEAPONS

For four centuries from 700BCE, heavily armed citizen-soldiers called hoplites ("armed men") formed the armies of the Greek city-states. Each soldier typically provided all of his weaponry and armour at his own expense: a bronze corselet (made up of a bell-shaped breastplate and backplate), a helmet, greaves, a sword, a spear, and a large round shield. Fighting in tightly packed phalanxes, the soldiers were very well protected, although still vulnerable to spear-thrusts around the groin and throat, or to wounds inflicted by missiles before they closed in on the opposing army's line.



Cheek guard

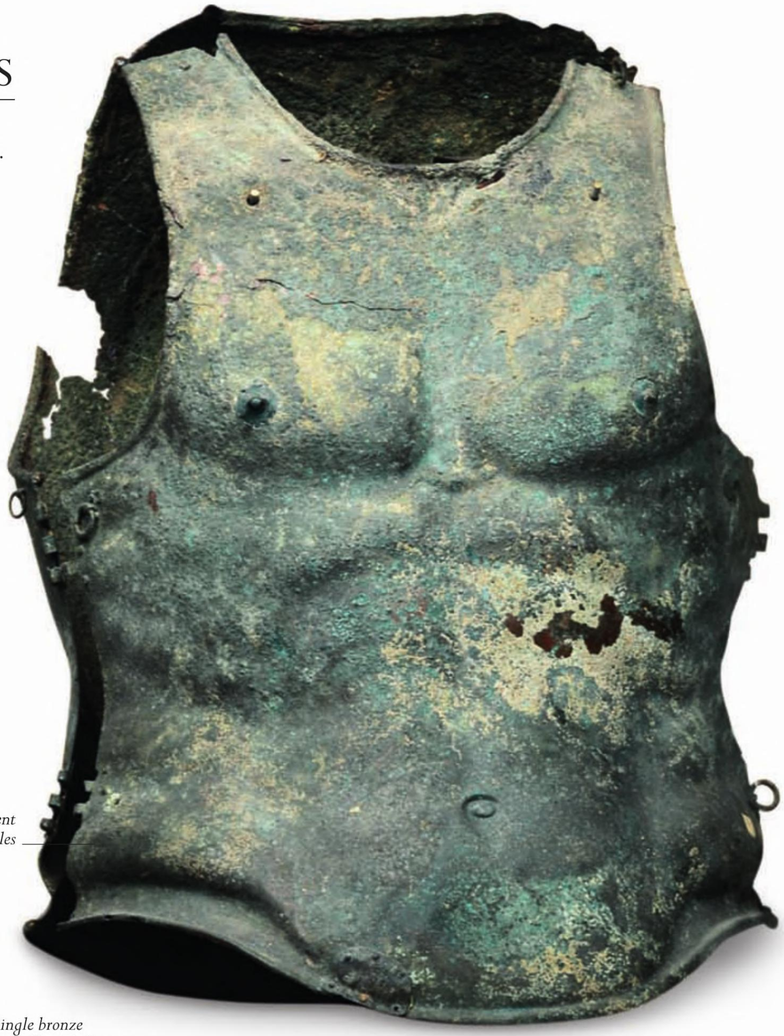
◀ CORINTHIAN HELMET

Date Late 7th century BCE

Origin Greece

Material Bronze

The Corinthian was the most common form of hoplite helmet, made from a single piece of bronze. It protected the whole head, with only a T-shaped opening for the eyes, nose, and mouth. An inner lining helped cushion the wearer's head.



Moulding to represent warrior's muscles

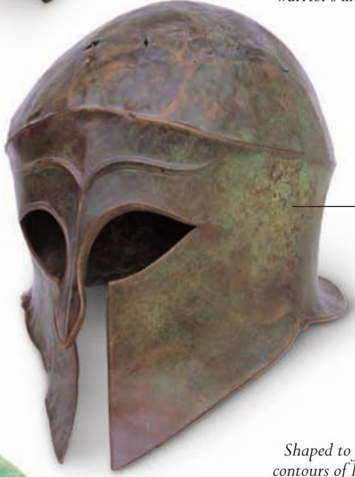
▲ BRONZE CUIRASS

Date 8th century BCE

Origin Greece

Material Bronze

The backplate of the hoplite cuirass was secured to the front with hinges and rings for leather straps. The front was moulded to the contours of the wearer's torso, suggesting that these cuirasses were probably crafted for individuals. Full plate cuirasses fell out of fashion around 500BCE.



Single bronze piece forms helmet

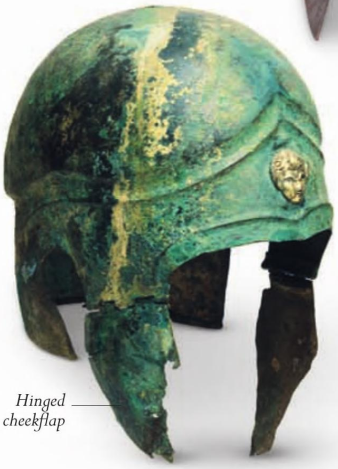
▶ LATE CORINTHIAN HELMET

Date 6th century BCE

Origin Greece

Material Bronze

More developed Corinthian helmets, such as this example, had sharply angled side pieces and thinner, more delicate nose protectors with a more pronounced neck guard. It is the type of helmet most commonly depicted on Corinthian vases.



Hinged cheekflap

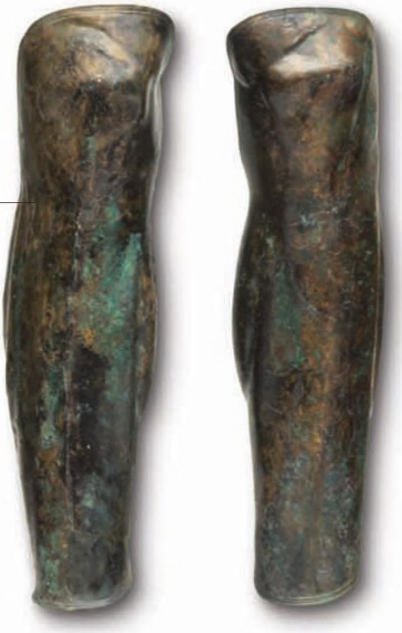
◀ ATTIC HELMET

Date 5th century BCE

Origin Greece

Material Bronze

The Attic helmet was a further development of the Chalcidian – a type that had more rounded cheekpieces than the Corinthian. However, the Attic gave lighter protection, with more space around the ears and hinged cheekflaps. It was often decorated on the front above the forehead.



Shaped to fit contours of leg

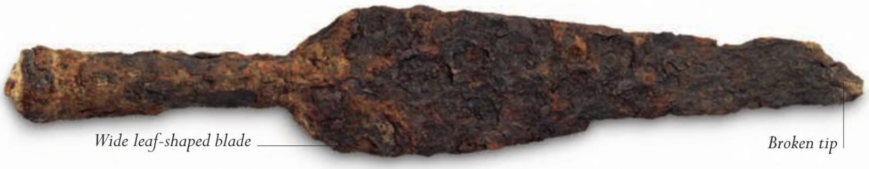
◀ BRONZE GREAVES

Date 6th century BCE

Origin Greece

Material Bronze

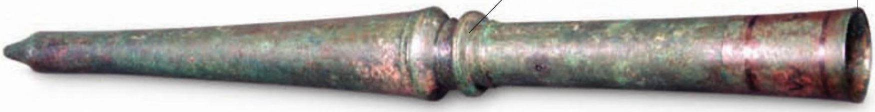
While the hoplite's thighs were covered by his shield, the greaves protected the knees and shins. The greaves were thin and shaped to the wearer's legs, allowing them to be snapped into place without the need for straps or ties.


Wide leaf-shaped blade
Broken tip

▲ GREEK SPEARHEAD

Date	6th–5th centuries BCE
Origin	Greece
Weight	370g (13oz)
Length	31cm (12¼in)

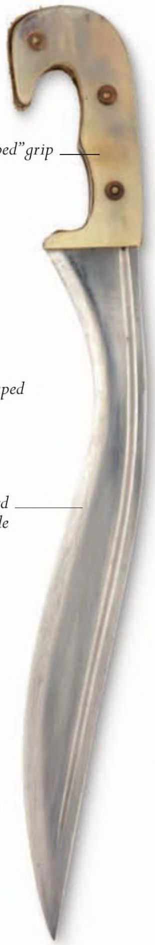
The spear was the hoplite's main weapon; the *kopis* (short sword) was used only if the spear broke during fighting. Originally hoplites carried two spears that could be thrown, but these were later replaced by one long, thrusting spear.


Indentation for bronze securing ring
Socket for spear shaft

▲ HOPLITE SPEAR BUTT

Date	4th century BCE
Origin	Macedonia
Length	38cm (15in)

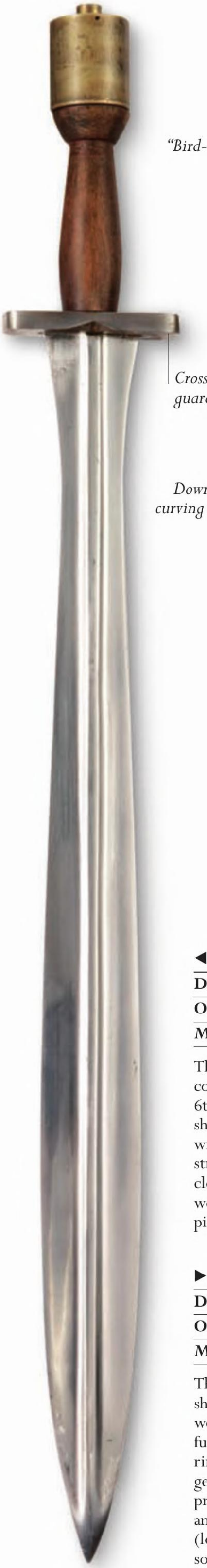
As hoplite spears grew longer, particularly from the 4th century BCE in the phalanxes of Philip of Macedon and Alexander the Great, they needed a counterweight to balance the spear-point at the other end. The spear butt provided this support and could also be used as a weapon if the spearhead broke.


"Bird-shaped" grip
Downward curving blade

◀ KOPIS

Date	5th century BCE
Origin	Greece
Material	Iron

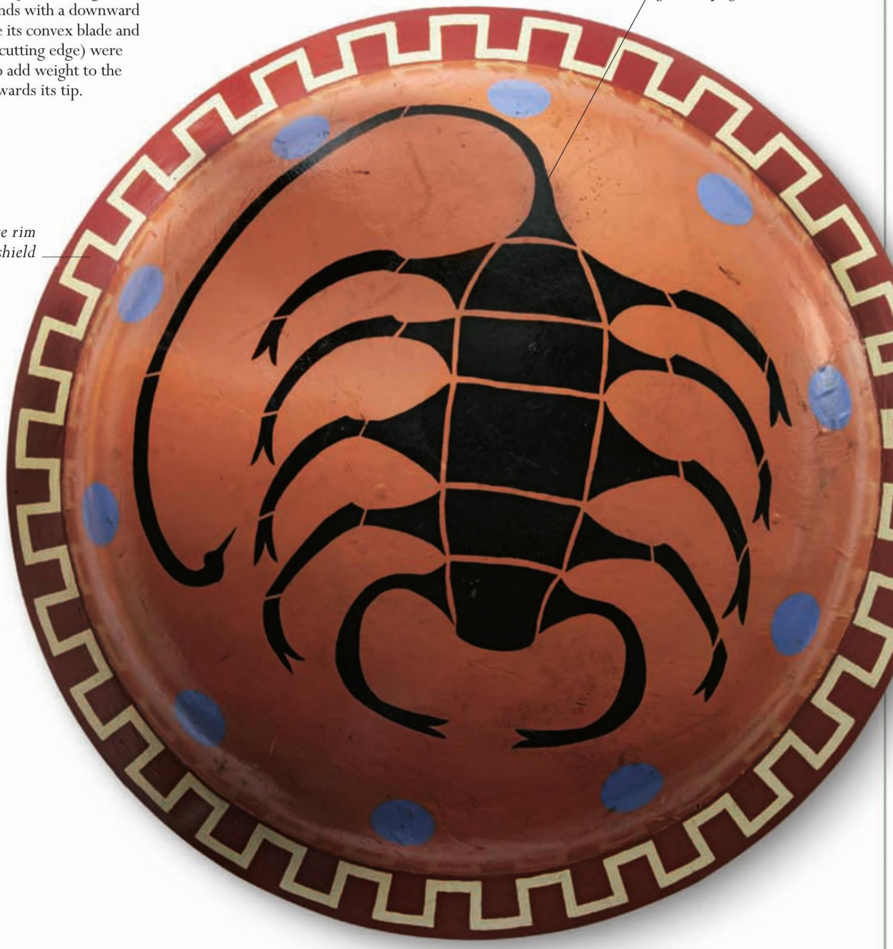
The *kopis* appeared in the late 6th century BCE, replacing earlier, broader, slashing blades. As can be seen in this modern replica, its curved shape was designed to inflict wounds with a downward slash, while its convex blade and back (non-cutting edge) were designed to add weight to the weapon towards its tip.


Cross-shaped guard

◀ XIPHOS

Date	Early 6th century BCE
Origin	Greece
Material	Iron

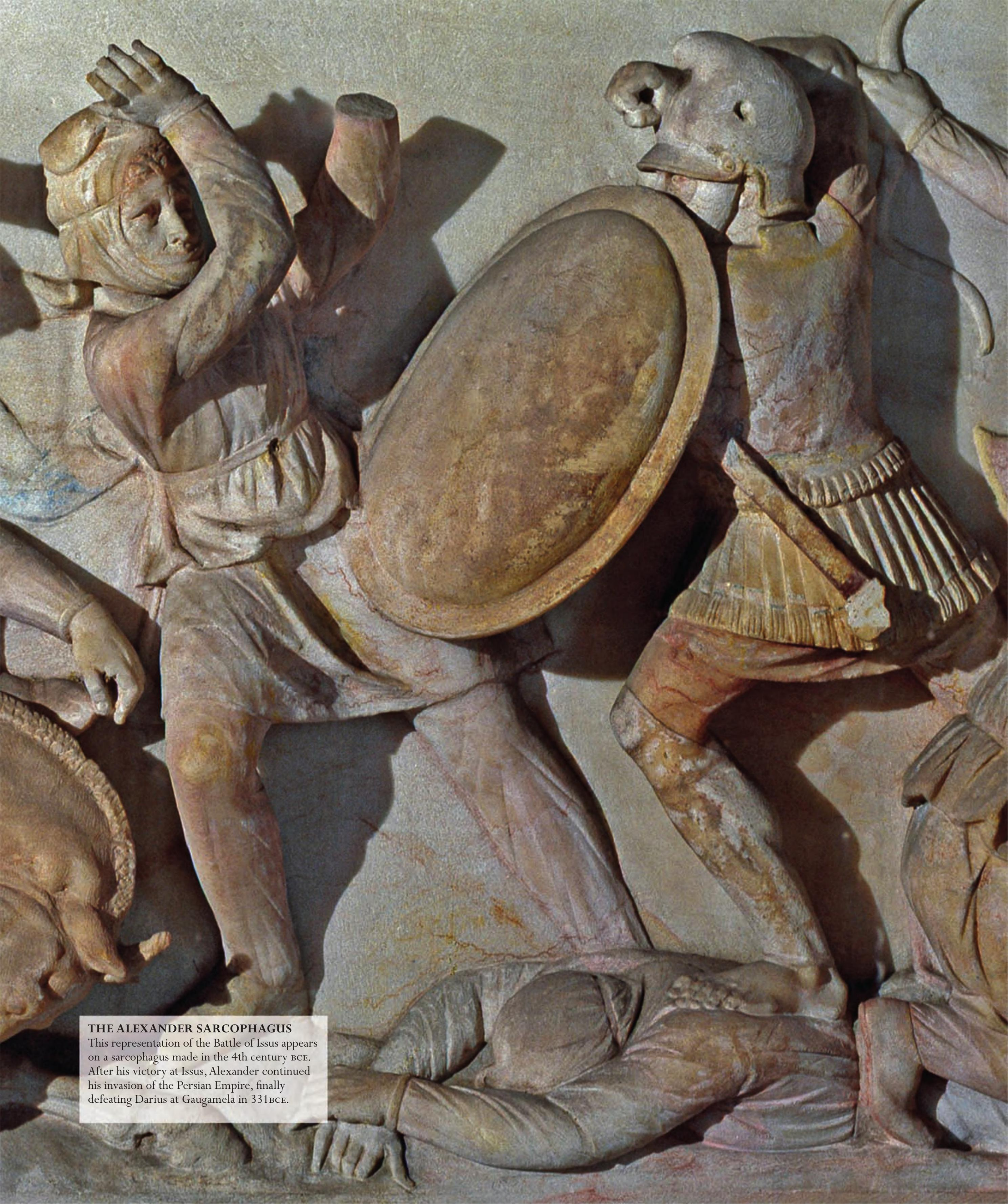
The *xiphos* was the sword most commonly carried by hoplites in the 6th century BCE. Its thick hilt had a cross-shaped guard and the blade swelled to a wide point near the tip, making it a very strong weapon. Used for thrusting in close combat, it was carried in a sheath worn under the left arm. The version pictured here is a modern replica.


Scorpion was Spartan symbol of the city of Geronthrae
Bronze rim of shield

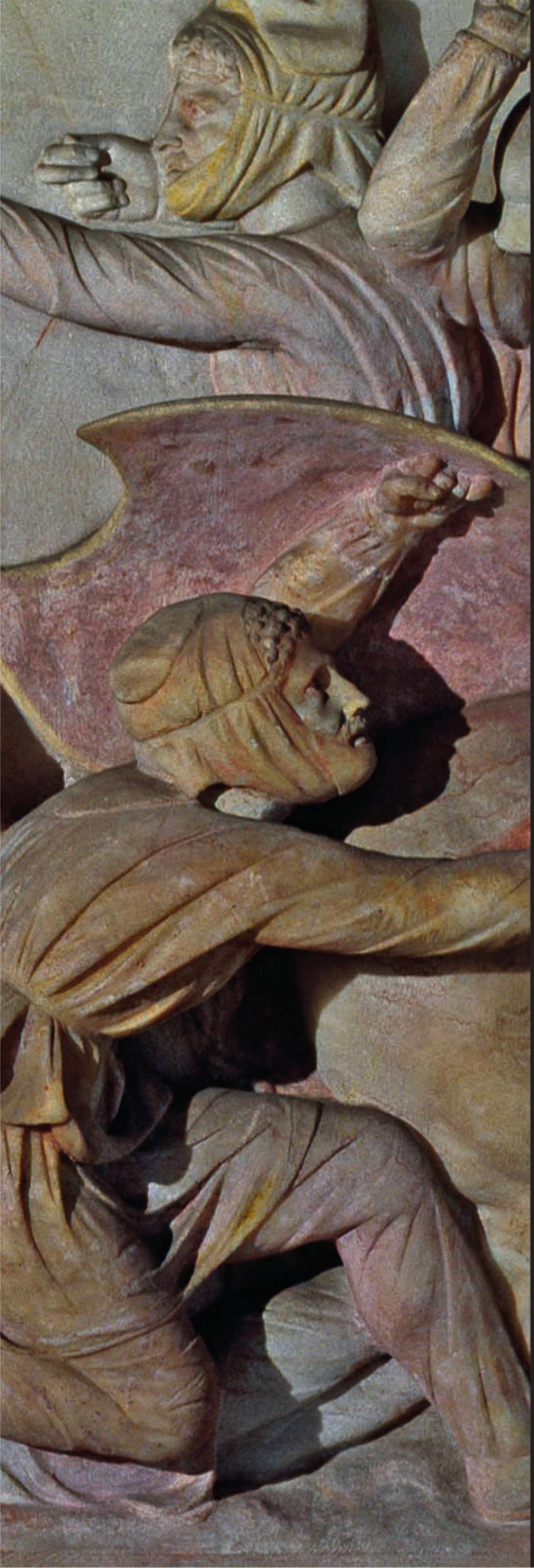
▶ ASPIS

Date	c.500BCE
Origin	Greece
Material	Wood, bronze

This modern replica of an *aspis* (or *hoplon*) shield is made from wood, although they were also often covered with bronze, with further bronze reinforcement around the rim. Up to 1m (3ft) in diameter, they gently curved inwards to provide some protection to the soldier's sides, and had an *antilabe* (handle) and a bronze *porpax* (loop) on the back. This allowed the soldier to carry a weapon and a shield in the same hand.



THE ALEXANDER SARCOPHAGUS
This representation of the Battle of Issus appears on a sarcophagus made in the 4th century BCE. After his victory at Issus, Alexander continued his invasion of the Persian Empire, finally defeating Darius at Gaugamela in 331BCE.



PHALANX AND CAVALRY

THE BATTLE OF ISSUS

The Macedonian army of Alexander the Great achieved remarkable conquests in the 4th century BCE, invading and destroying the mighty Persian Empire. Alexander's defeat of the Persians at Issus in 333BCE exemplified the Macedonian use of infantry phalanxes flanked by heavy cavalry.

As Alexander advanced along the eastern Mediterranean coast, the Persian ruler Darius III led an army through Syria to intercept him, reaching the sea behind Alexander's line of march. The Macedonians turned back and confronted Darius at Issus on a plain between the sea and the foothills of the Amanus Mountains. Alexander's army was outnumbered – possibly 40,000 men to the Persians' 100,000 – but the restricted battlefield made it difficult for Darius to use his larger force to outflank the Macedonian line.

The Persians took up a position behind a river, fortifying its banks with wooden palisades. On the other side of the river, Alexander arranged his forces in a traditional fashion. His elite Companion cavalry took up position on the right, by the foothills, and the subsidiary Thessalian cavalry on the left, beside the sea. In the centre were the infantry – most of them organized into tightknit phalanxes armed with long, two-handed sarissa pikes. The Macedonian phalanxes were usually 16 ranks deep, but at Issus the ranks were thinned to eight to spread the troops more widely. The Macedonians also deployed more flexible hypaspists – elite infantry equipped with shorter spears, swords, and pikes – and swarms of light skirmishing troops armed with bows, javelins, and slings.

Darius opened the battle, sending soldiers to infiltrate through the hills, but the Macedonian skirmishers countered this outflanking manoeuvre, halting the Persians with arrows and stones. The main body of heavily armoured Persian cavalry, supported by slingers running alongside the horses, charged along the beach on the Macedonian left, but was contained and then repulsed by the Thessalian horsemen. In the centre, Alexander ordered his infantry to advance against the Persian line, where Greek mercenary hoplites employed by Darius were drawn up in phalanxes with their traditional bronze armour, shields, and spears. As the Macedonian foot soldiers began to ford the river and scale the palisades on the far side, their own phalanxes lost formation, opening gaps in the ranks of pikes into which the enemy could penetrate.

TACTICAL PROWESS

The struggle in the centre, however, was not Alexander's main tactical gambit – he intended to triumph through a cavalry charge on the right. With Alexander himself at their head, the Companion cavalry rode forward. The horsemen wore bronze cuirasses and helmets, but did not carry shields. Each was armed with a lance and a sword, mostly the curvaceous *kopis*. Having neither saddle nor stirrups, the men gripped their mounts firmly with their knees as they smashed into a mix of Persian light infantry, archers, and cavalry. The point of attack was well chosen, and the Persian left wing collapsed in the face of the onslaught. Already engaged with the Macedonian infantry to their front, Darius's Greek mercenaries were now exposed to cavalry attack from the flank and rear. Darius himself, on a command chariot behind his army, was also under threat. The Persian emperor fled the field, leaving his soldiers to be massacred or to scatter in search of safety.

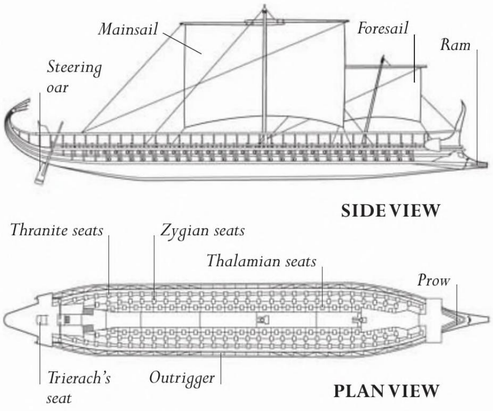
GREEK TRIREME

OLYMPIAS

The Greeks were famed for their naval prowess, using light, fast galleys called triremes. No trireme has survived from antiquity, but the *Olympias* is a reconstruction based on historical evidence.

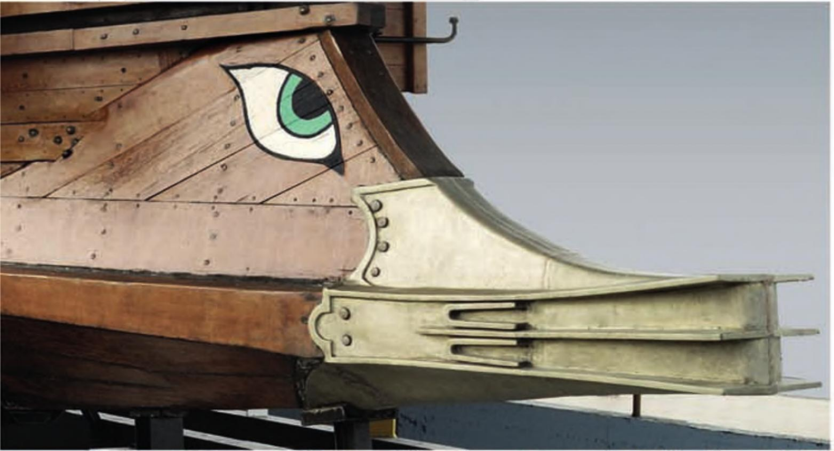
A Greek trireme was a shallow-draught vessel some 35m (115ft) long and less than 6m (20ft) wide. It cruised under sail, but in battle it was propelled by 170 oarsmen – all free citizens – in three tiers: 62 thranites on top, 54 zygians in the middle, and 54 thalamians at the bottom. With around 30 other men completing the crew, including marine hoplites and archers, it was a crowded vessel. There was room to carry only a few basic supplies and insufficient space for the whole crew to sleep on board.

The *Olympias* was built at Piraeus, Athens, between 1985 and 1987. It proved highly manoeuvrable in sea trials, reaching speeds of almost 8 knots under oar and turning about in twice its own length. In action, a trireme with a skilled helmsman and a disciplined crew could ram an enemy vessel or ride over its oars, then reverse and leave it crippled in the water. If its own hull was holed, a trireme would not sink because it was made from buoyant wood such as pine, poplar, or fir.



▲ THE *OLYMPIAS*
The side view shows the arrangement of the two sails and the three tiers of oar ports. The plan view shows the position of each individual oarsman's seat.

PROW AND HULL



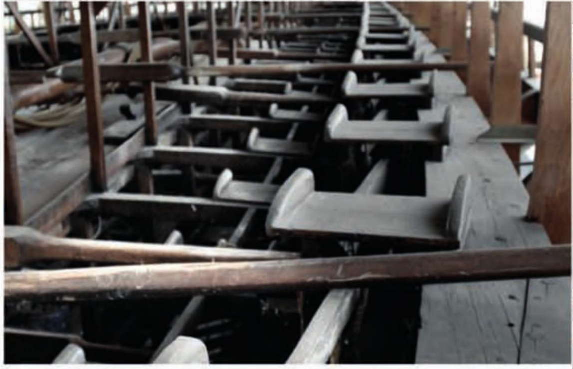
► SAILING AT SPEED
Under sail, and with a favourable wind, the *Olympias* achieved a speed of almost 11 knots.

◄ BRONZE RAM
A trireme's prow terminated in a bronze-clad ram for holing the hulls of enemy galleys in battle. The ram on the *Olympias* weighs 200kg (440lb).

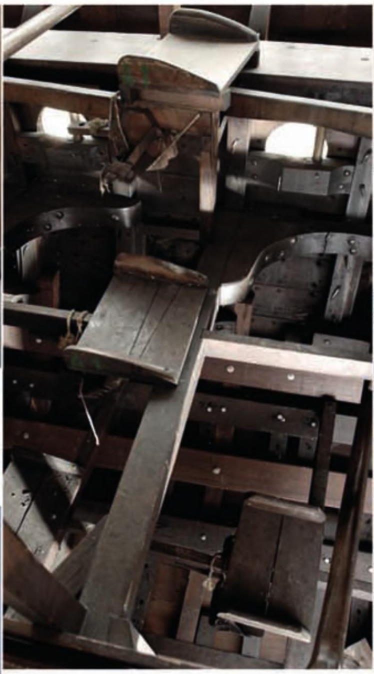
▲ EAR AND ANCHOR
Sailors dropped and weighed anchor from platforms called *epotides* (ears) near the prow. The ears also protected the thranite oarsmen behind.

► OUTRIGGER
Built out from of the hull, the outriggers allowed the thranites on the upper tier to row from a position outboard of the two lower tiers.

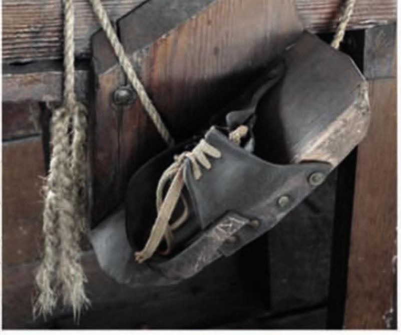
OARS AND OARSMEN



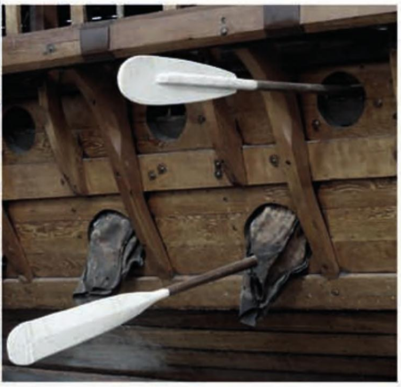
▲ THRANITES' BENCHES
The rowers on the topmost tier, the thranites, had the toughest job, because of the angle at which their oars entered the water. Consequently, they commanded higher wages than the other rowers.



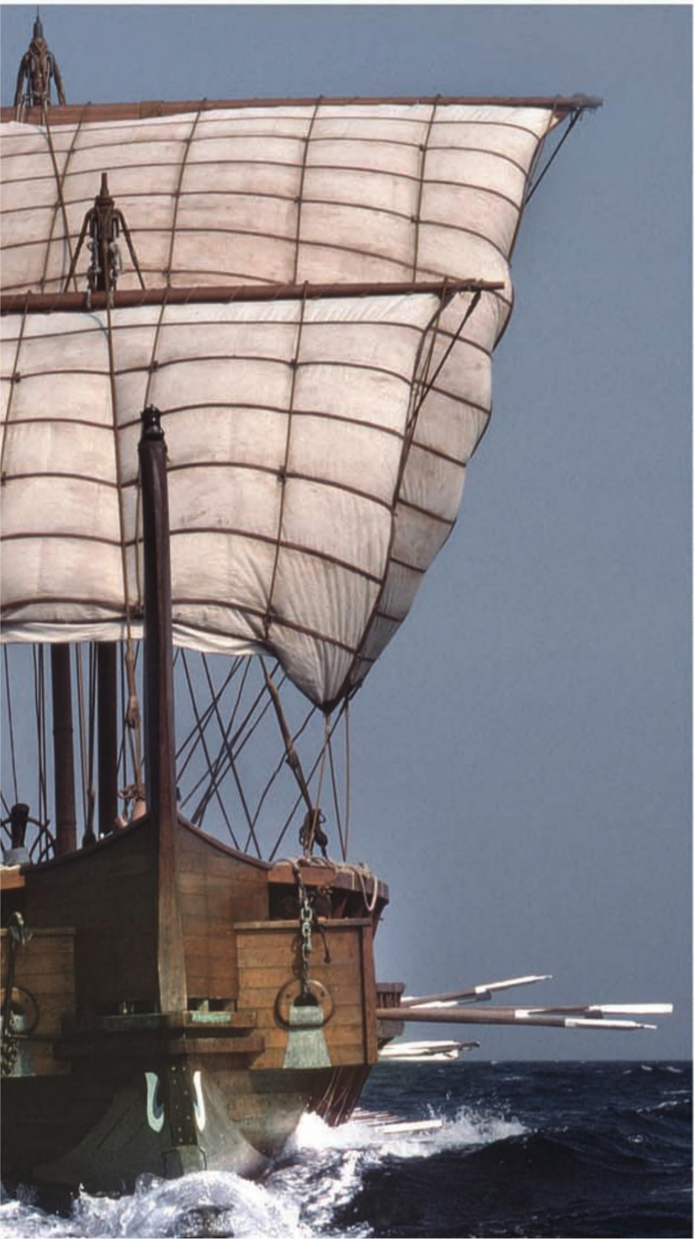
▲ SEATS FOR OARSMEN
The rowers' conditions were cramped. Each seat was level with the shoulders of the oarsman on the tier below.



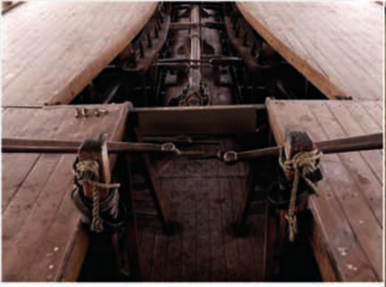
▲ FOOT STRETCHER
The crew of the *Olympias* experimented with various rowing techniques, including securing one foot to the stretcher.



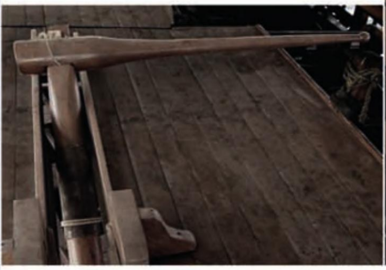
▲ TIERS OF OARS
The tiers were staggered to prevent oars from clashing. The lowest oars had leather sheaths to keep water out of the hull.



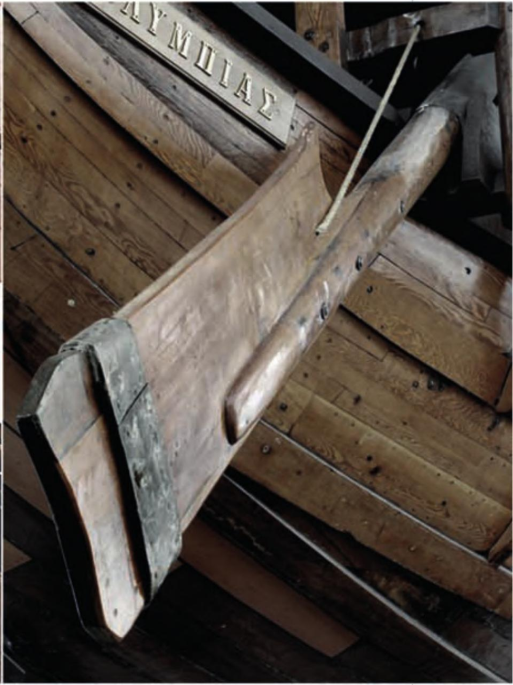
STEERING THE BOAT



▲ VIEW FROM THE STERN
The helmsman, who steered using a pair of tillers, overlooked the central slot between the decks, where the mast was stowed when not in use.



▲ TILLER
A single helmsman normally controlled both tillers, but if more force was required a man was assigned to each one.



▲ STEERING OAR
Operated by the tillers, the pair of steering oars (rudders) could also be used as brakes to slow the ship's forward movement.

KEY DEVELOPMENT

THE ROMAN WAR MACHINE

Until the collapse of the western Roman empire in the 5th century CE, the Roman legions formed the most formidable army of the Ancient World. Primarily an infantry force, it underwent a number of changes during its time of dominance.

The early Roman army was a citizen militia, drawn mainly from the wealthier classes. It owed its early successes to Rome's ability to conscript large numbers of recruits in times of war, and to its formidable tactical organization and training, which were far superior to those of its Italian enemies. The early legions had three categories of heavy infantry – the *hastati*, who were the least experienced, the *principes,* the best-quality troops, and the *triarii*, the veterans. The *hastati* and *principes* were armed with heavy javelins (*pila*), whereas the *triarii* had thrusting spears (*hastae*). The legionaries were protected by bronze helmets and semi-cylindrical body shields and, from the mid-3rd century BCE, they were armed with a short sword – the *gladius hispaniensis* – that became known as their signature weapon.

Drawn up in these three lines – each divided into 10 maniples (units) of around 150 men – the legion fought in much the same way as many ancient armies. Supporting cavalry (*equites*) and light infantry (*velites*) would attempt to turn the enemy flank, while the heavy infantry tried to breach their opponents' line. Few armies could match the Romans in number or skill, but the legion suffered major setbacks when faced with the tactical genius of the Carthaginian general Hannibal, during the Second Punic War.

THE MARIAN REFORMS

Although the Roman army ultimately won the Second Punic War, its performance during the 2nd century BCE was lacklustre and it struggled in

KEY **FIGURE**

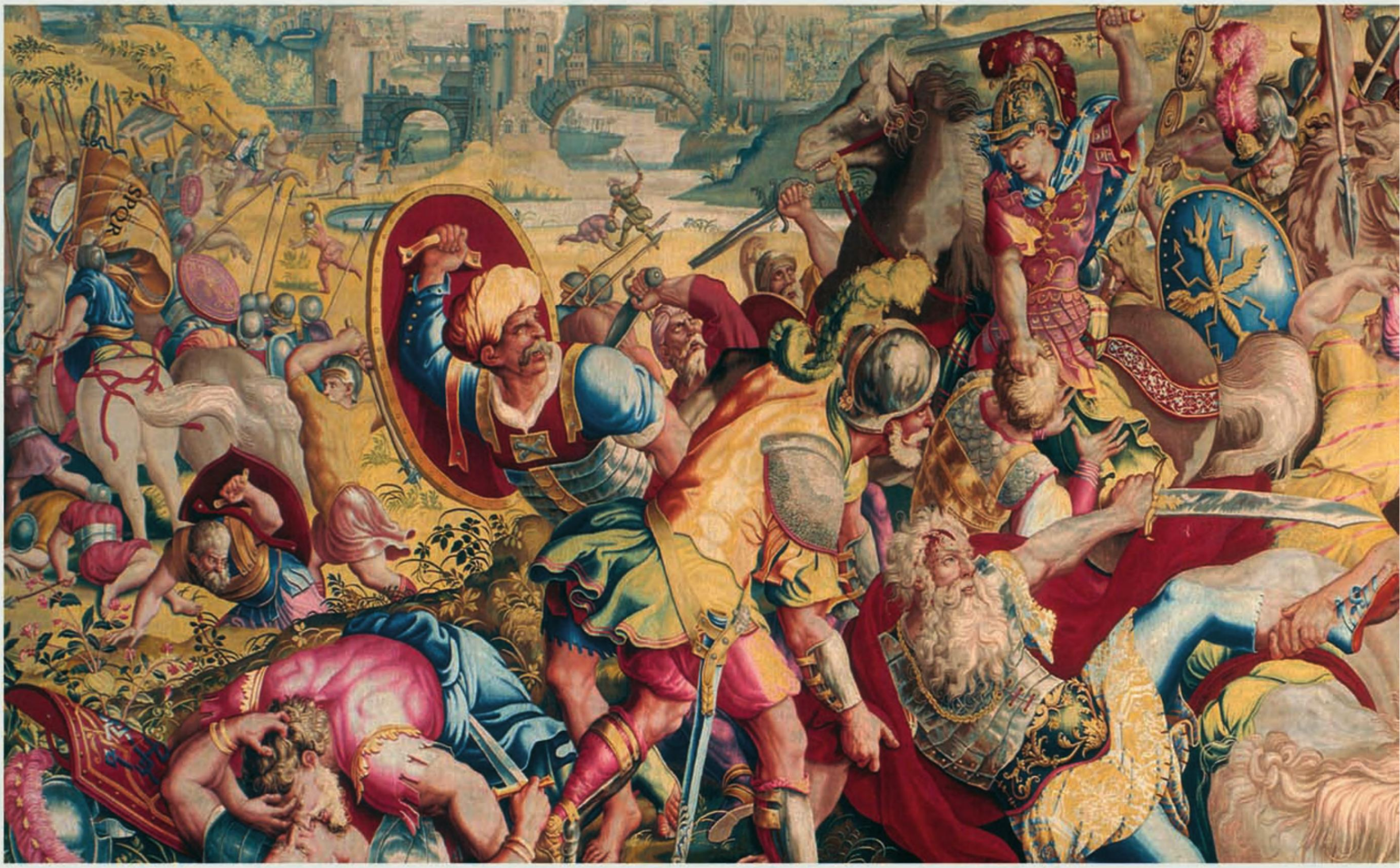
JULIUS CAESAR

100–44BCE

Roman general Julius Caesar secured his reputation in a series of campaigns in Gaul, from 58 to 50BCE, securing large new provinces for Rome. Dogged and tactically adept, Caesar ruthlessly suppressed tribes who opposed him, such as the Belgae and Nervii, and was made dictator for life. Soon after, however, he was assassinated.

◄ At the time of his assassination, Julius Caesar was planning further military conquests, of the Dacians and the Parthians.

▼ **THE BATTLE OF THE TREBIA**
In 218BCE, Hannibal turned the Roman flanks by defeating their cavalry, then attacking from the rear.



> “The **Romans** instil into their **soldiers fortitude** not only of **body** but also **soul**”
>
> **JOSEPHUS**, *THE JEWISH WAR*, c.75CE

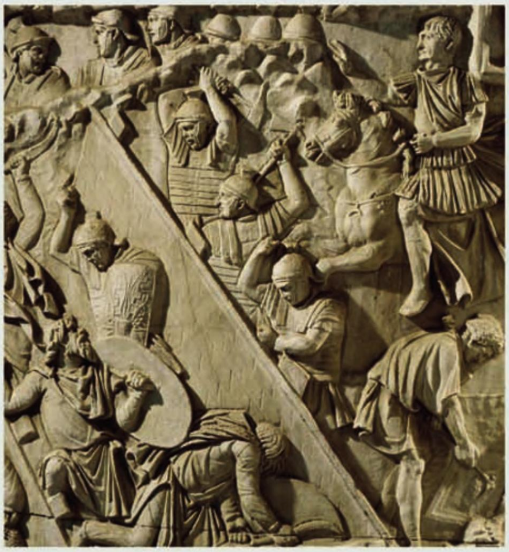
wars against the Numantines, in Spain, and against Jugurtha, King of Numidia, in North Africa. From 107BCE, the Roman general Marius instituted a number of reforms. The army became a permanent force, not recruited afresh each campaigning season, and it became open to all, rather than only the propertied classes. There was now just one form of heavy infantry, issued with standardized equipment – the *pilum*, the *gladius*, mail armour, and the *scutum*, a long rectangular shield. A more flexible tactical sub-unit – the cohort – also came into use. This consisted of 480 men, divided into six centuries (a unit of 80 men).

THE LEGIONS UNDER THE EMPIRE

The new army was supremely well-drilled and disciplined. It could advance to within 15m (50ft) of the enemy and would then let off a volley of javelins and charge. Once at close quarters, the legionaries used their shields to strike enemies, then stabbed them in the stomach with their short swords. Highly trained, they were able to withstand a cavalry charge by using their javelins to form a type of phalanx (see pp.24–25). They rarely lost field battles against infantry forces, and their skill in siege warfare meant that only mobile opponents with strategic depth, such as the horse archers of the Parthian Empire, were able to fend them off. With back-up provided by professional auxiliaries – slingers, archers, and even specialist camel troops – armed with a wider range of weapons, the legions conquered much of Europe, North Africa, and the Middle East.

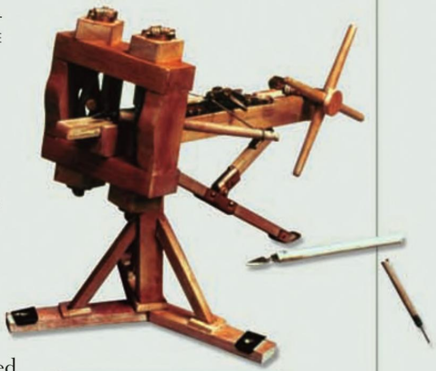
THE LATE ROMAN ARMY

Under the later empire, the Roman army became more diverse and was composed of smaller units. Smaller, oval or round shields were used instead of the *scutum* and lighter spears (*lancea*) replaced *pila*. Cataphracts (heavily armoured cavalry) came into service, and the army became more adapted to defending the Empire’s frontiers, rather than engaging in aggressive field battles. An increasing reliance on foreign mercenaries – mostly Germanic – meant that, by the fifth century, the Roman Empire’s western provinces had few military resources of its own able to hold back waves of barbarian invaders – a factor that contributed to the empire’s fall in 476CE.



◀ TRAJAN’S CAMPAIGN
A scene from Emperor Trajan’s campaign against the Dacians, in 105–06CE, shows the Romans fending off an attack from a field fortification.

▼ ROMAN ARTILLERY
Roman legions carried field artillery with them. The bulk of these were ballistas – giant torsion operated machines that shot lead-tipped bolts.



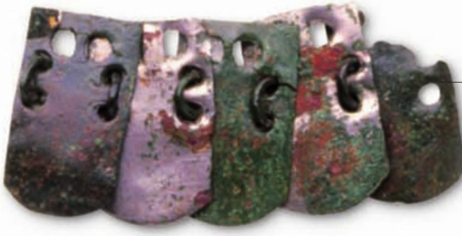
KEY **EVENTS**

2600–750BCE

- **264–241BCE, 218–201BCE, 149–146BCE** The Punic Wars between Rome and Carthage, in North Africa, end in a Roman victory. During the Second War, the Carthaginian general Hannibal crosses the Alps into Italy, defeating the Romans at Trebia and Cannae, but failing to capture Rome.
- **102BCE** At the Battle of Aquae Sextiae, Roman general Marius defeats the invading Teutones, who threaten to overwhelm Italy. This is the reformed Roman army’s first success.
- **58–50BCE** Julius Caesar conquers Gaul, defeating numerous tribes and finally overcoming the resistance of the Gallic leader Vercingetorix at the decisive Siege of Alesia.
- **27BCE** Augustus becomes the first Roman emperor. After a long period of civil war, he reduces the number of legions from around 60 to 28, all of which now pledge their loyalty to the emperor rather than to a variety of generals.
- **101–02, 105–06CE** Emperor Trajan defeats the Dacian king Decebalus during the Dacian Wars. Dacia province becomes an outpost of the Roman Empire.
- **378CE** Gothic barbarians defeat the main field army of the eastern Empire at the Battle of Adrianople. Emperor Valens perishes during the battle – Rome’s worst military disaster for nearly 400 years.

ROMAN LEGIONARY'S ARMOUR AND WEAPONS

The Roman legionary, the mainstay of the Roman army, fought in legions roughly 5,000 strong. Their equipment was well adapted for fighting in close formation, each soldier being equipped with two *pila* (javelins) that could be hurled, and a *gladius* (short stabbing sword), which was used in hand-to-hand fighting. The dimensions of the equipment changed over time – a longer slashing sword, the *spatha*, came to be preferred over the *gladius*.


Overlapping scales

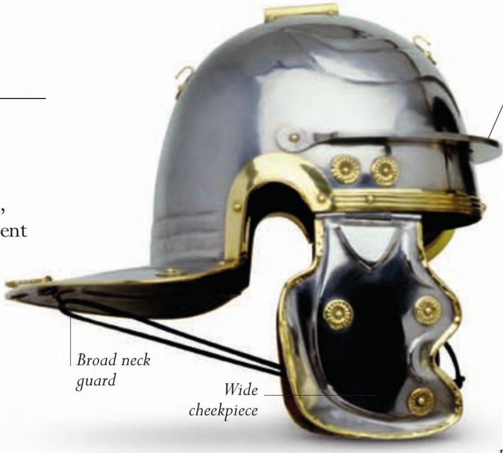
▲ LORICA SQUAMATA

Date 1st century CE

Origin Roman Empire

Material Iron

Legionaries often wore armour of overlapping metal scales a few centimetres long, made of copper or iron, bound together with iron and sewn onto a cloth underpiece. By the late 1st century CE, it was increasingly superseded by *lorica segmentata*.


Brow guard
Broad neck guard
Wide cheekpiece

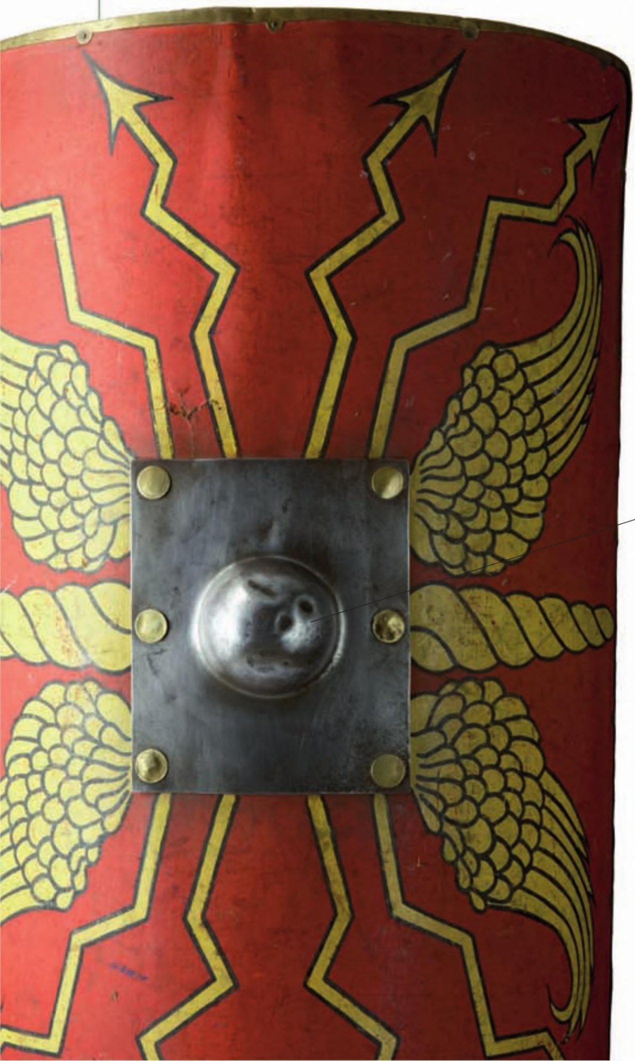
◀ GALLIC HELMET

Date Late 1st century CE

Origin Roman Empire

Material Iron

This modern replica depicts an Imperial-Gallic helmet that was influenced by Celtic models and had a deeper neck guard than earlier Roman helmets, which made it harder to crouch and dictated a more upright fighting style for its wearers.


Central boss deflected spear and sword thrusts

◀ SCUTUM

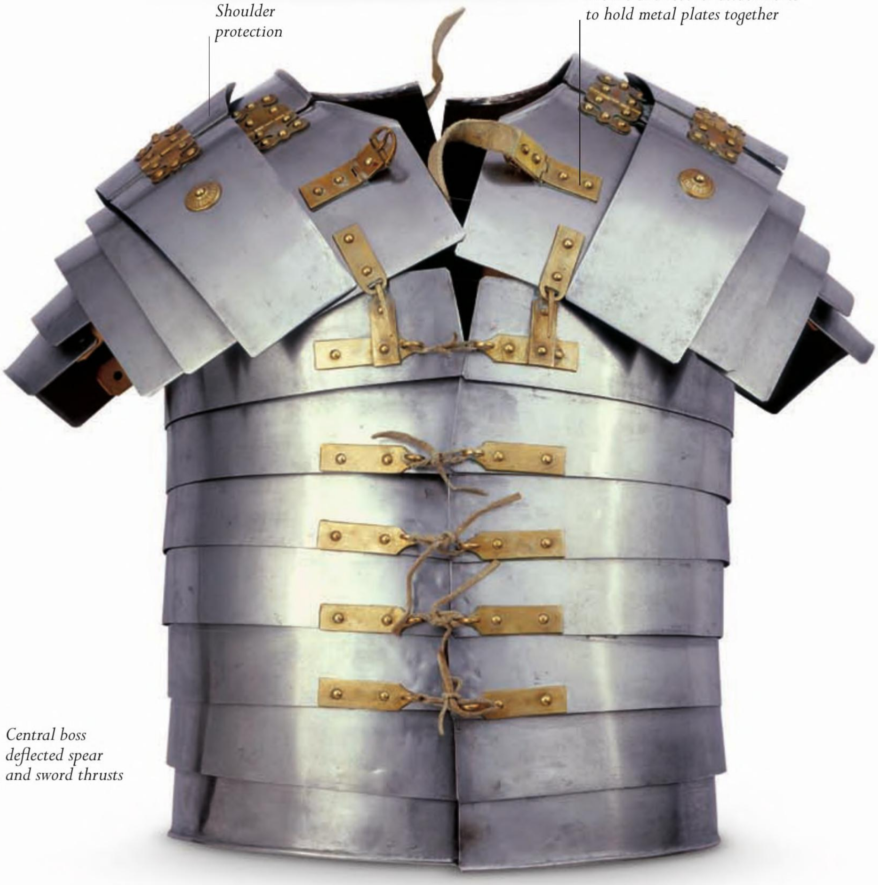
Date 1st century CE

Origin Roman Empire

Weight 6.8–9kg (15–20lb)

Width 73cm (29in)

The *scutum* (legionary shield) was a long rectangle that curved inwards to form a part cylinder, giving greater protection to its wearer. As depicted on this modern replica, it was adorned with legionary insignia. When not in use, it was protected by a leather cover.


Shoulder protection
Bronze and leather attachments to hold metal plates together

▲ LORICA SEGMENTATA

Date Late 1st century CE

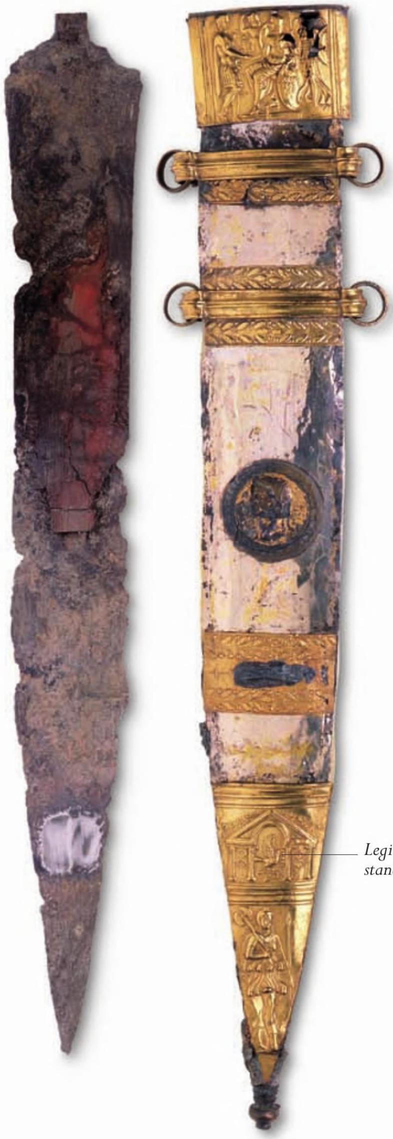
Origin Roman Empire

Material Iron, bronze, leather

This modern replica Roman armour is made up of overlapping iron plates with leather straps running underneath. It probably had its origins in gladiatorial equipment and, although providing good protection, the complicated fittings made it hard to maintain.

Long, tapered point

Triangular tip



Legionary eagle standard in shrine

◀ GLADIUS AND SCABBARD

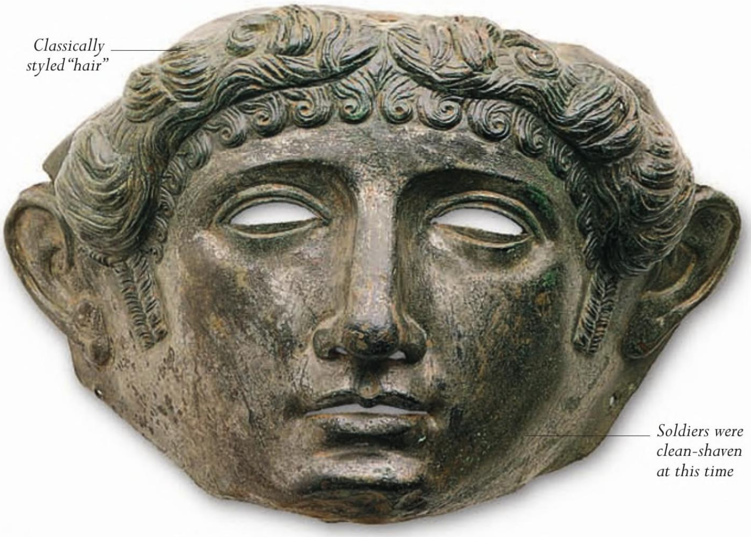
Date	c.15 CE
Origin	Rome
Length	57.5cm (22½in)

This *gladius* (legionary sword) and ornate scabbard was probably presented by the Emperor Tiberius to a favoured officer. Its decoration shows the Emperor dedicating a victory to his stepfather Augustus.

▲ PUGIO

Date	1st century CE
Origin	Roman Empire
Material	Steel

The legionary's *pugio* (dagger) was a backup weapon if his sword could not be deployed. It was worn on the left for ordinary soldiers and frequently had an ornate scabbard inlaid with metal or enamel. The object shown here is a modern replica.



Classically styled "hair"

Soldiers were clean-shaven at this time

▲ MASK FOR CAVALRY SPORTS

Date	1st century BCE–1st century CE
Origin	Nola, Italy
Material	Bronze

At military displays, cavalrymen wore ornate helmets with face masks, often when they took part in mock battles. The mask was attached to the main part of the helmet with leather straps, and a crest and streamers added to the impressive appearance.

Regimental brand

▶ SLING BULLETS

Date	3rd–1st centuries BCE
Origin	Roman Empire
Weight	37.5–64.5g (1¼–2¼oz)
Length	3.2–4.4cm (1¼–1¾in)

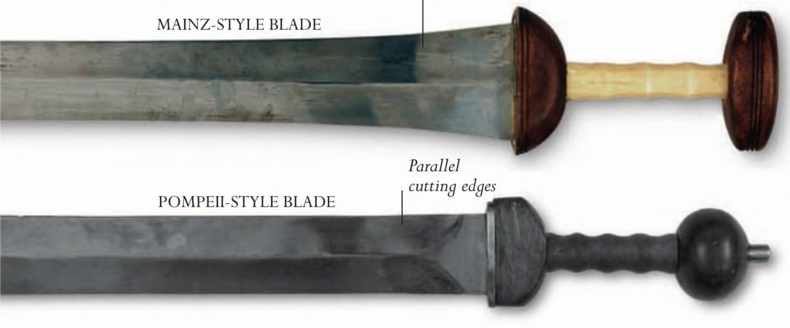
Roman armies included lighter-armed troops, whose weaponry included slings with lead pellets such as these. The legions also had some heavier artillery that shot larger, pointed bolts.

HASTA
PILUM

▶ PILUM AND HASTA

Date	Late 1st century CE
Origin	Roman Empire
Length	2m (6½ft)

The Roman military *pilum* (javelin) was a throwing weapon, designed so that its pointed head would break off on hitting a target, making it impossible to hurl back. The *hasta* (thrusting spear) was a more substantial spear, used to thrust in close-quarter combat. The versions shown here are modern replicas.



Waisted blade

Parallel cutting edges

◀ GLADII

Date	1st–3rd centuries CE
Origin	Roman Empire
Weight	700–900g (25–32oz)
Length	65–70cm (26–28in)

Based on a short Spanish sword, the *gladius* had a narrow blade with a long point, making it effective for stabbing and thrusting. As can be seen in the modern replicas pictured here, the blade shape evolved from the waisted "Mainz" style to the straight-edged "Pompeii" type, which then evolved into the longer, straight-bladed *spatha* (slashing sword).

KEY DEVELOPMENT

THE ENGINEERING OF ROMAN CONQUEST

The Roman legionaries were not only excellent in combat – they were also highly skilled military engineers, who were called upon to build forts, roads, and siege-works throughout the empire.

A Roman legionary's entrenching tools, it was said, were as dear to him as his sword. When on campaign, legionaries built a marching camp every evening, using a formulaic design that allowed them to organize encampments for up to 5,000 soldiers. Sited on level ground, the camps were usually rectangular, surrounded by a V-shaped ditch and an earth rampart bristling with wooden spikes that the legionaries carried with them.

Once an area was conquered, more permanent forts were built (see p.38), also based on this "playing-card design" – so-called because they had rounded corners. Each fort had four main gates, one of which (the *porta praetoria*) faced enemy territory; a network of roads; and a central block of buildings that contained the *praetorium* (commander's house), the *principia* (headquarters), and a shrine for the legionary standards.

Forts were built in various sizes, to accommodate either whole legions or smaller auxiliary cohorts (around 500 men). They sometimes formed part of complex linear defences, or even walls (such as Hadrian's Wall in Britain). Over time, the earth and turf of many of the original forts were replaced with stone, and, during the later empire, the walls were stronger and had projecting corner towers allowing missile cross-fire. These developments reflected the fact that the forts had become places the army needed to defend, rather than bases from which to dominate the surrounding territory.

ROMAN SIEGES

The legionaries put their skill at constructing fortifications and ramparts to good offensive effect in siege warfare, as they encountered enemy bastions as diverse as the hill-forts of Gaul and Britain, and the elaborate walled towns of Judaea. If an enemy fort could not be taken by stealth, it had to be surrounded and starved out or, as a last resort, stormed. To isolate an enemy position, the Romans built complex siege-works of ramparts, often with towers from which to fire heavy catapults. At the Siege of Alesia, Julius Caesar oversaw the building of 35km (55 miles) of ramparts that hemmed in Gaulish chieftain Vercingetorix, and cut off supplies. Vast earthworks called assault ramps intimidated

KEY **EVENTS**

146BCE–124CE

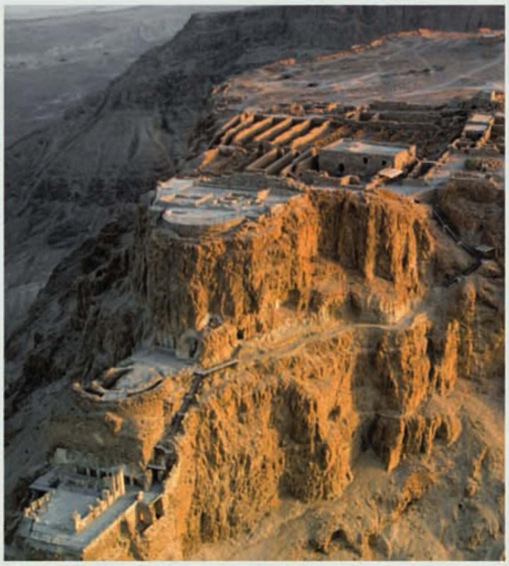
- **c.146BCE** Work begins on the Via Egnatia, a road that will enable Roman armies to access most of the Balkans from Italy.
- **134–133BCE** Roman forces, led by Scipio Africanus, besiege the Celtiberian stronghold of Numantia, surrounding it with fortifications (known as circumvallations) and attacking it with siege towers. The settlement falls after 16 months.
- **52BCE** Julius Caesar traps Vercingetorix, leader of the Gallic Revolt, at Alesia. Roman engineers build complex siege-works, preventing relief forces from coming to the defenders' aid.
- **73CE** Flavius Silva uses his engineers of the Tenth Legion to subdue the mountain fort of Masada.
- **122–24CE** Hadrian's Wall becomes the Romans' most complex border system. It is 117km (73 miles) long and punctuated by forts.

▼ **LEGION INSIGNIA**
Imperial legions were proud of their identity. This plaque shows the emblem of the Twentieth Legion, which took part in suppressing the Iceni revolt in Britain (60–61CE).

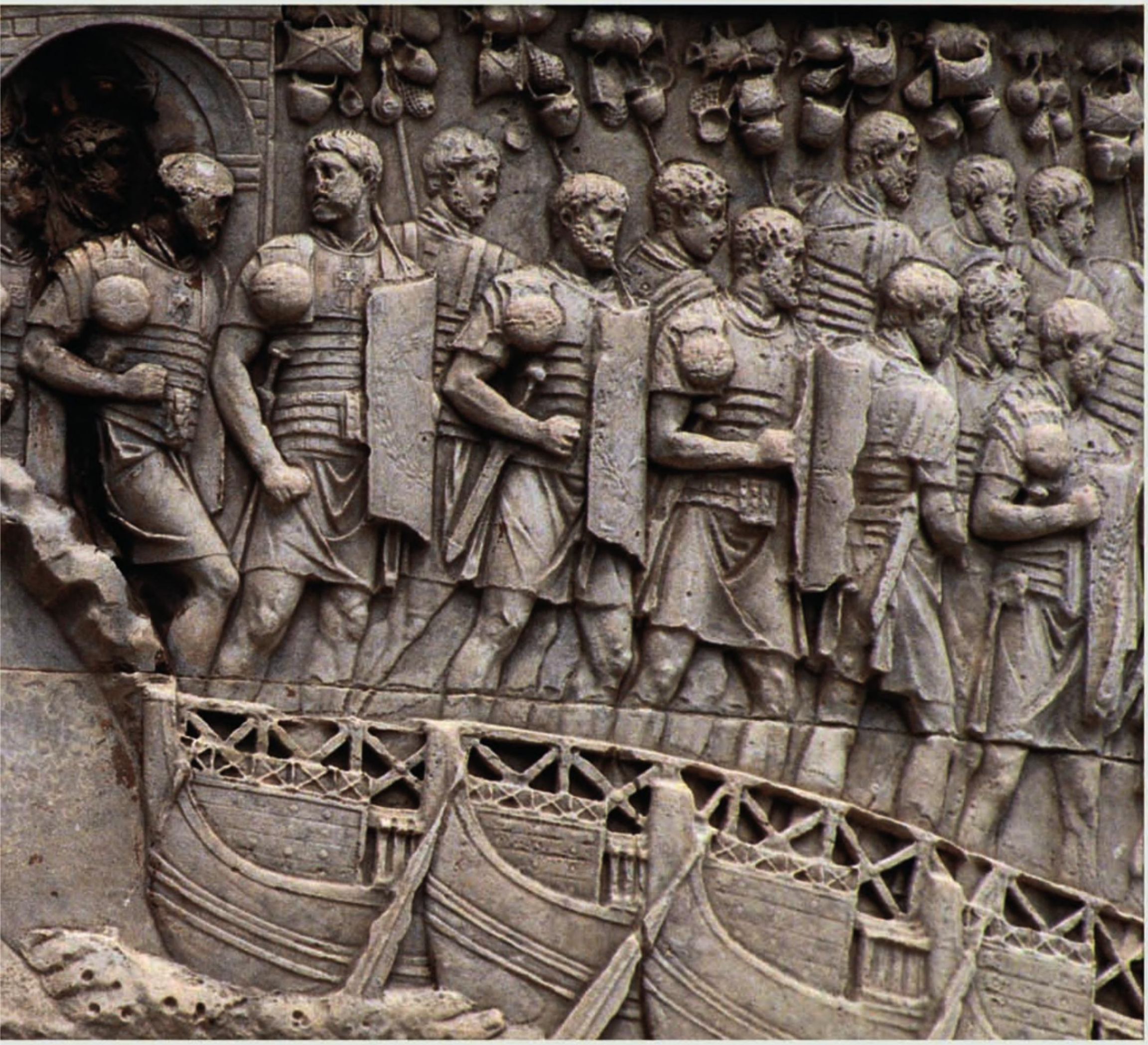
> "There was also **a tower** made of the height of **sixty cubits**, and all over **plated with iron**, out of which **the Romans threw darts and stones** from the engines"
>
> **JOSEPHUS**, *THE JEWISH WAR*, c.75CE

the besieged troops, provided the attackers with access to the walls for artillery points, and formed a platform for a final assault.

More than the surviving remains of their forts, the finest testament to the Romans' skills in military engineering is arguably the vast network of roads – some 120,000km (75,000 miles) long – they built to consolidate their rule. The first was the Via Appia, begun in 331BCE, which initially ran from Rome to Capua. Main roads linked the towns, making it possible to move troops quickly and to operate an efficient postal network. Military roads ran behind important frontiers, as in Britain and Germany. Roman roads were normally straight, regardless of local topography, and were carried over rivers and marshes by bridges or viaducts. Their durability owed much to their excellent construction, which involved a foundation of coarse gravel laid beneath layers of finer gravel, with large blocks of basalt added on top to form the pavement.



◄ **THE SIEGE OF MASADA**
To take possession of the inaccessible mountain fort of Masada, the last stronghold of the Jewish Revolt, in 73CE, the Romans had to build a counter-wall with towers and a gigantic assault ramp on which to mount a battering ram. The ramp was 225m (738ft) long and up to 200m (656ft) wide.



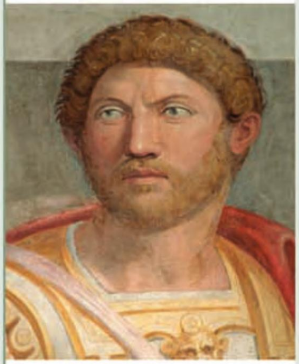
◄ **A DACIAN CONQUEST**
Roman legionaries are depicted on Trajan's Column (in Rome, dated 113CE) leaving a fortress to cross the Danube on a bridge of boats at the start of Trajan's Dacian War, in 101–02CE.

KEY **FIGURE**

HADRIAN

76–138CE

The emperor Hadrian ordered a retreat from advanced Roman positions in Scotland and had a wall built to mark the Roman frontier in northern Britain. It was defended by a complex series of forts, milecastles, and turrets.



▲ Hadrian consolidated the Roman Empire rather than expanding it. He even withdrew from some territories.

ROMAN FORTIFICATION

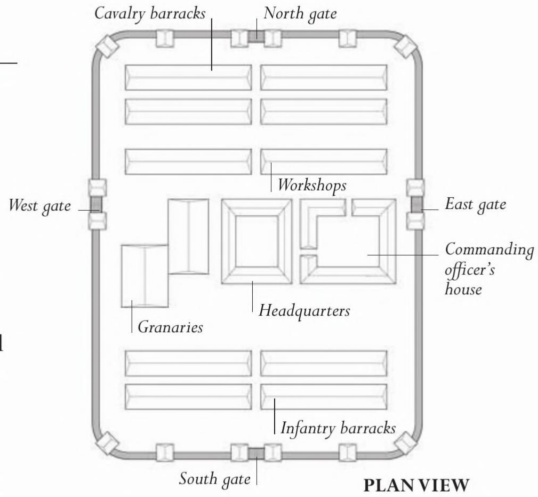
ARBEIA FORT

The Roman army built the ancient world's greatest fortifications. Legionaries were more like combat engineers than ordinary soldiers, being trained in construction as well as the art of battle.

On campaign, a legion made a wooden camp, surrounded by an earth rampart, at every stop. Permanent forts were initially also made of wood and earth, but later ones, like the reconstructed Arbeia, in northeast England, were stone-built. Used as barracks, administrative centres, and supply depots, they maintained a military presence in potentially hostile territory.

Outposts of Roman civilization, the forts made no concessions to local climates or cultures, displaying similar features across the empire. Living conditions were basic and cramped – units of eight soldiers called *contubernia*, or "tent groups", shared small, two-roomed suites in the barracks. However, with heated bathhouses and latrines cleaned by running water, hygiene standards were relatively high.

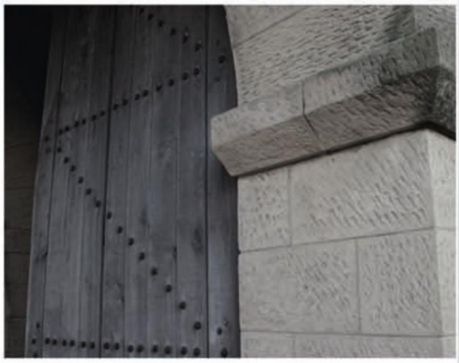
Arbeia was a small fort, housing about 600 auxiliary troops, both infantry and cavalry. Built in the 2nd century CE, it was a major supply centre for the troops on Hadrian's Wall to the north.



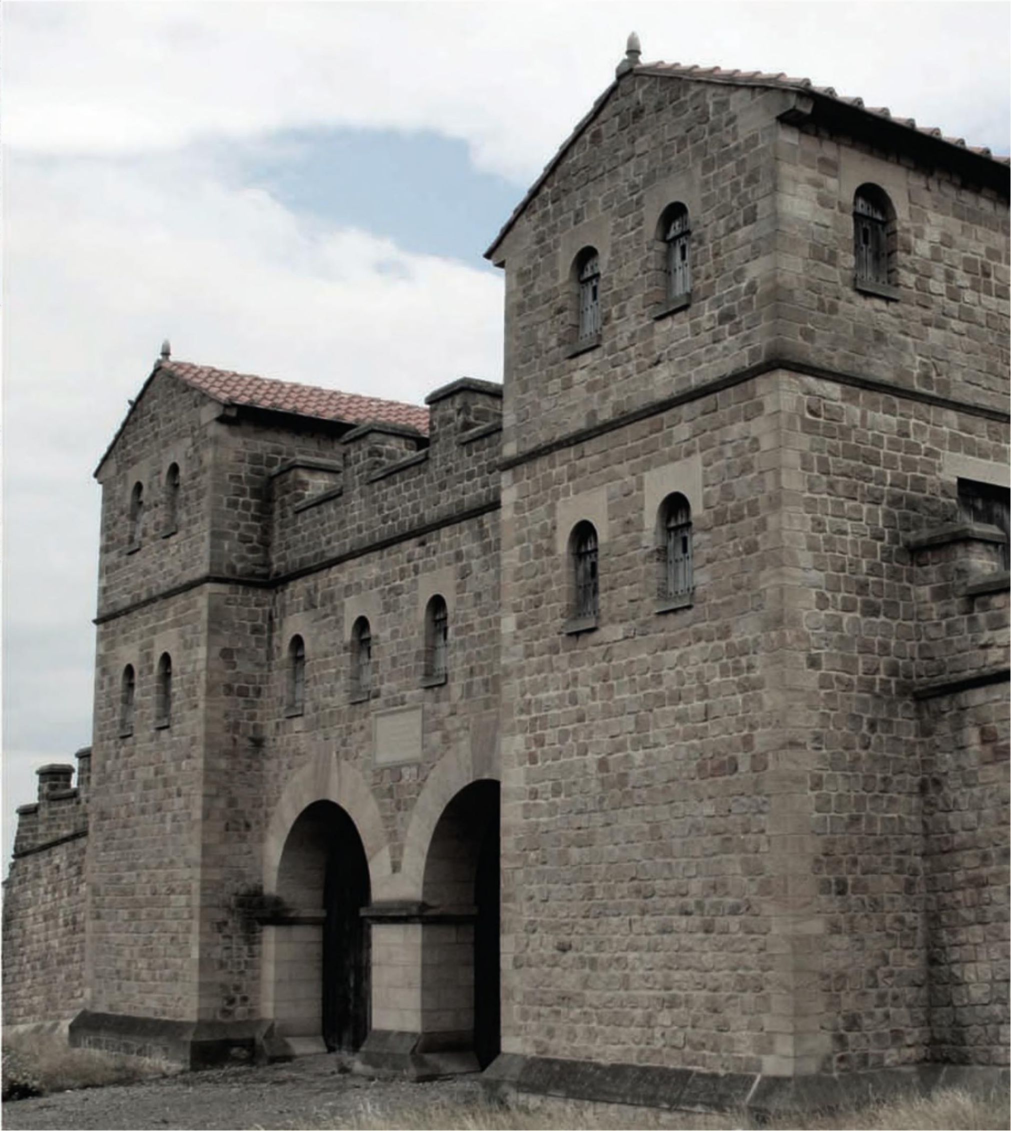
▲ LAYOUT OF A ROMAN FORT
Large or small, most Roman forts were built to a similar plan, with barracks for cavalry and infantry, workshops, granaries, and a separate headquarters.

FORT ENTRANCE

▲ GATEHOUSE PLAQUE
The plaque states that the fort was built by Legio VI Victrix under Sextus Calpurnius Agricola, governor of Britain (c.163–66CE).

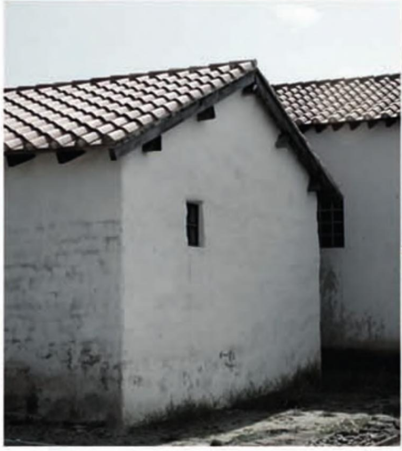


▲ DOORS AND WALLS
Solid stone walls and thick wooden doors would have kept out the bands of tribal fighters who occasionally carried out raids in Roman Britain.

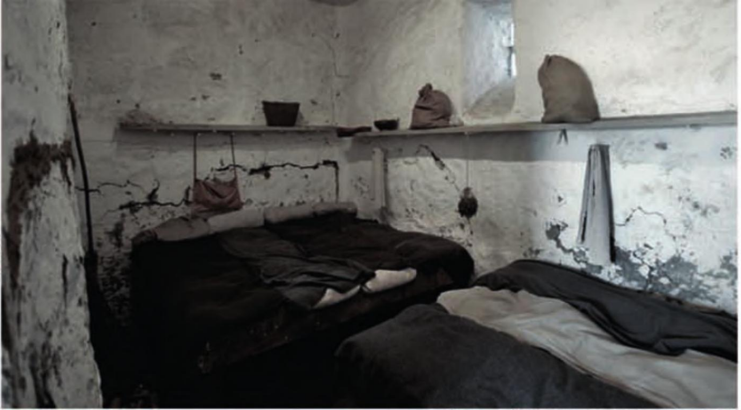


► GATEHOUSE
Although the twin towers of Arbeia's gatehouse are imposing, they are smaller than those at some other Roman forts and city walls.

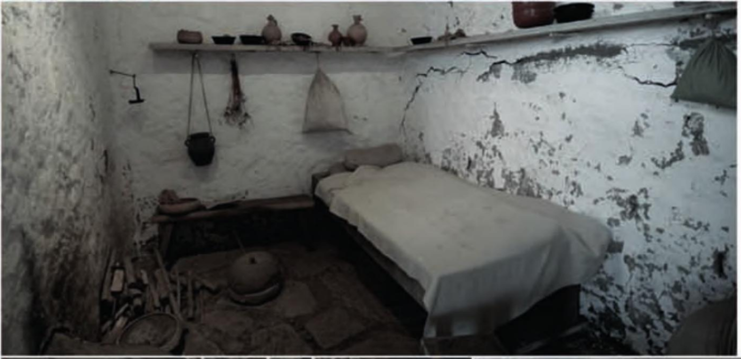
CONTUBERNIA SUITE



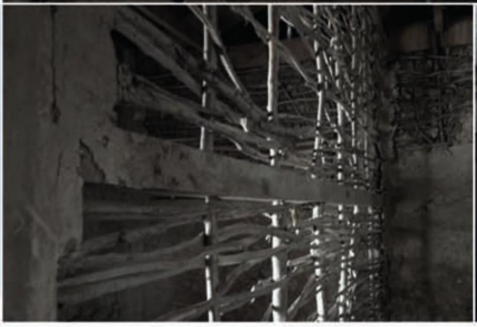
▲ **BARRACK BLOCKS**
Each plastered-stone block housed five *contubernia*. There were a few small windows, and ventilators were set into the roof.



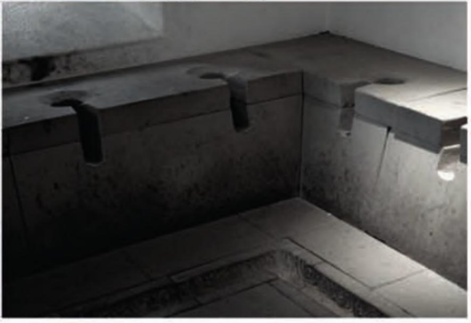
◄ **DORMITORY**
The eight soldiers of a *contubernium* slept in the larger room of their suite, either under woollen blankets on simple beds or on straw-filled mattresses on the floor.



◄ **SMALL ROOM**
The smaller room of a *contubernium*'s suite was used as either a living area or a storage space for the soldiers' military equipment.

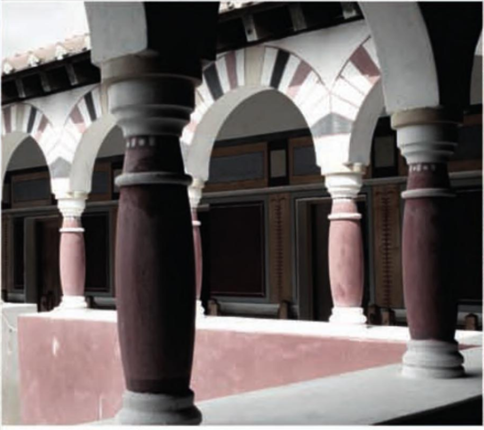


▲ **INTERIOR BARRACK WALLS**
The internal walls were made of wattle-and-daub – a woven wooden lattice (wattle) daubed with a mixture of straw, mud, and animal dung.

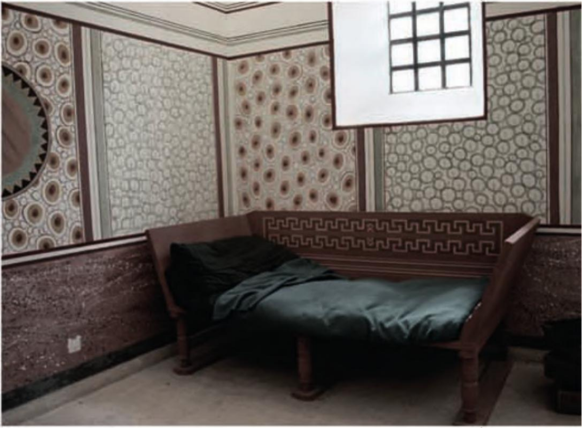


▲ **BATHHOUSE LATRINES**
There was also probably a bathhouse for the troops outside the fort. Its communal latrines lacked privacy, but they had high-quality plumbing.

OFFICER'S HOUSE



▲ **COURTYARD**
The commanding officer lived in a comfortable house within the fort. It had an open courtyard and rooms leading off a colonnaded walkway.



▲ **HEATED BEDROOM**
The commander's bedrooms were large, decorated, and warmed by the hypocaust (underfloor heating). Beds were often richly carved or painted.

ENEMIES OF ROME

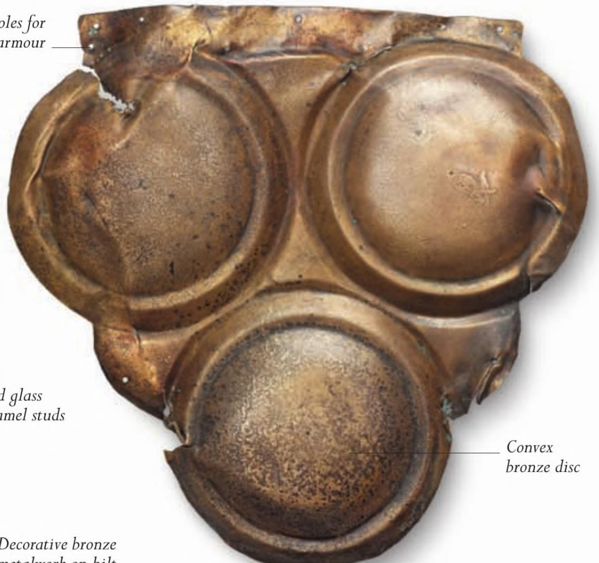
The expansion of Rome's influence from a small settlement in central Italy to an imperial power that ruled a huge empire brought its armies face to face with a wide range of foes. Although the individual equipment of most enemy warriors may have been superb, their training and organization was almost always inferior to that of the Roman army. However, the Roman infantry did struggle against the mounted warriors of Persia and the Hunnish archers, and by the time the Franks, the Ostrogoths, and other Germanic groups poured into the empire from the 4th century CE onwards, the Roman army was too weakened to resist them.

Bronze wings

▼ BRONZE SAMNITE BREASTPLATE

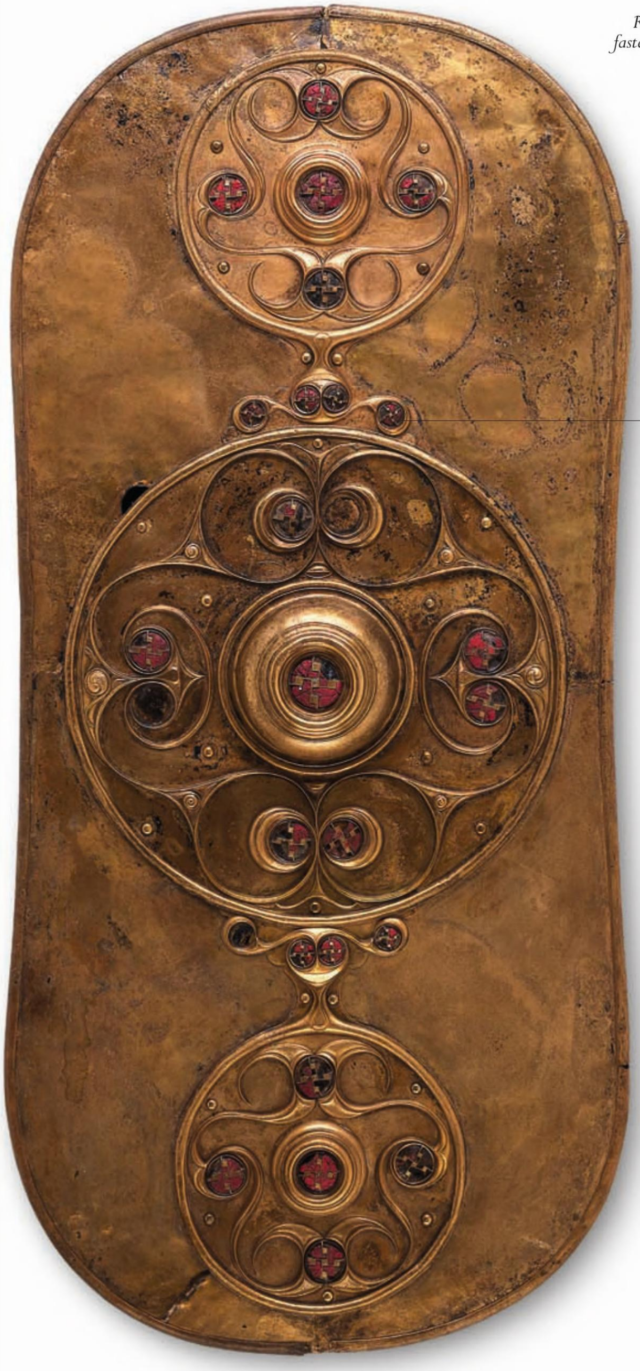
Date	4th century BCE
Origin	Central Italy
Material	Bronze

Made of three convex bronze discs, this breastplate would have been matched by a similar piece to protect the back. Such armour was worn by Rome's opponents, the Samnite tribes, in three wars in central Italy from 343–290BCE.

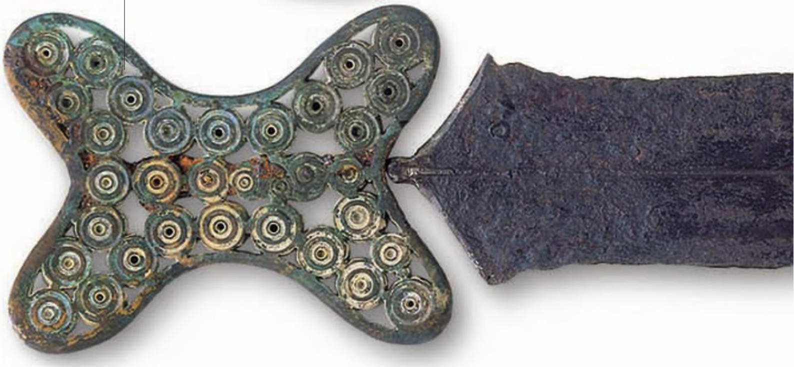


Rivet holes for fastening armour

Convex bronze disc



Red glass enamel studs



Decorative bronze metalwork on hilt

◄ BATTERSEA SHIELD

Date	350–50BCE
Origin	England
Weight	3.4kg (7½lb)
Diameter	35.7cm (14in)

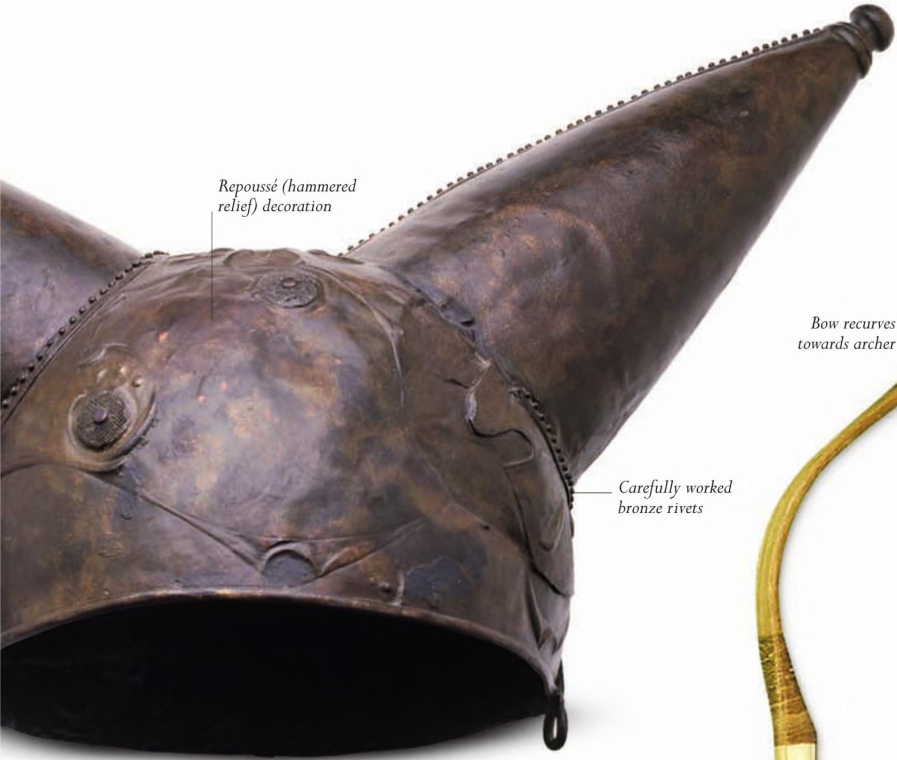
This ornate decorative bronze cover to a wooden shield, found in the River Thames at Battersea, London, was probably for parade use. It is made of four sheets of bronze riveted together.

▲ CELTIC DAGGER

Date	250–50BCE
Origin	England
Length	27.8cm (11in)

The intricate spiral-pattern decoration on this Celtic dagger indicates that it was probably intended for funerary or display purposes, rather than combat. Its sharply tapering blade was typical of everyday weapons.

Silver-covered scabbard


Repoussé (hammered relief) decoration
Carefully worked bronze rivets

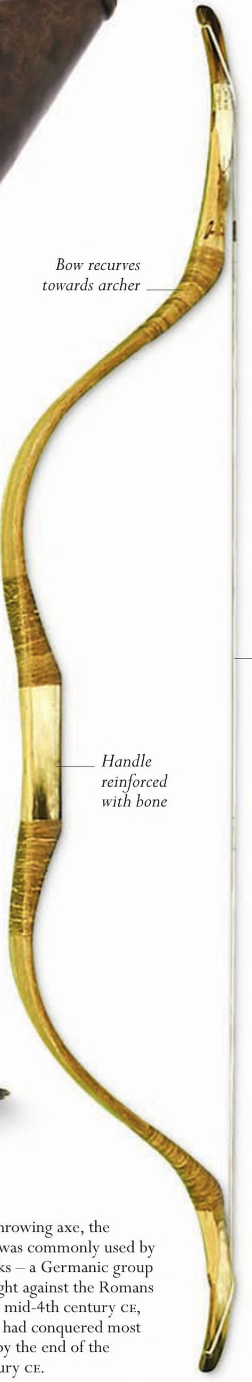
▲ BRONZE HELMET

Date 250–50BCE

Origin England

Material Bronze

This horned helmet is the only one of its type ever found in Europe, and was probably for ceremonial rather than combat purposes. It is made of bronze sheets riveted together.


Bow recurves towards archer
Bowstring
Handle reinforced with bone

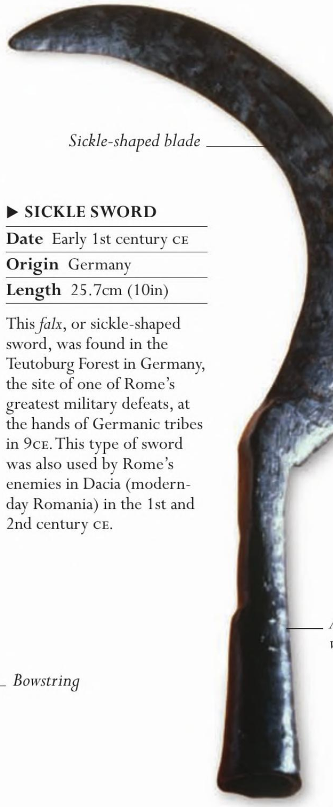
▶ HUNNISH BOW

Date 5th century CE

Origin Central Europe

Length 1.25–1.65m (4–5½ft)

The Huns employed compound bows made of horn and wood, which had a greater range than simple bows. The Huns depended on a rapid rate of fire from horseback for their military successes against the Romans in the 5th century CE. The version pictured here is a modern replica.


Sickle-shaped blade
Attachment for wooden haft

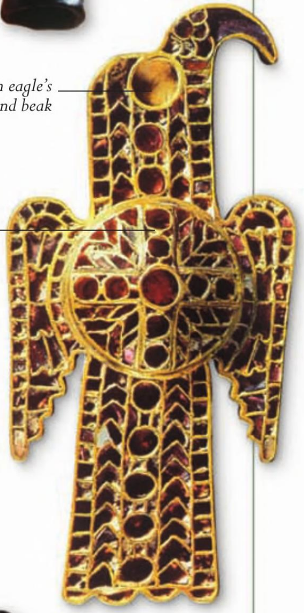
▶ SICKLE SWORD

Date Early 1st century CE

Origin Germany

Length 25.7cm (10in)

This *falx*, or sickle-shaped sword, was found in the Teutoburg Forest in Germany, the site of one of Rome's greatest military defeats, at the hands of Germanic tribes in 9CE. This type of sword was also used by Rome's enemies in Dacia (modern-day Romania) in the 1st and 2nd century CE.


Jewels form eagle's eye and beak
Cloisonné cross pattern

▶ EAGLE CLASP

Date c.500CE

Origin Italy

Material Gold, cloisonné

This eagle clasp was probably used to fasten the cloak of a high-status warrior. It comes from the Ostrogoths, a people who occupied Italy from the late 5th century CE.

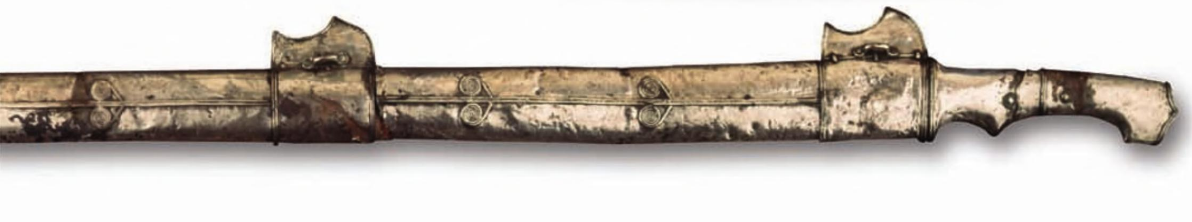
▼ SASSANIAN PERSIAN SWORD

Date 6th–7th century CE

Origin Persia

Length 1.05m (3½ft)

Late Sassanian Persian swords were long with narrow blades. They were hung from the belt by two straps, which prevented the scabbard from trailing on the ground and allowed the rapid drawing of the sword.



▼ FRANCISCA THROWING AXE

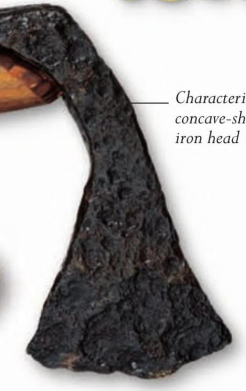
Date 500–600CE

Origin Europe

Weight 430g (15¼oz)

Length 16.5cm (6½in)

A light throwing axe, the *francisca* was commonly used by the Franks – a Germanic group who fought against the Romans from the mid-4th century CE, and who had conquered most of Gaul by the end of the 5th century CE.

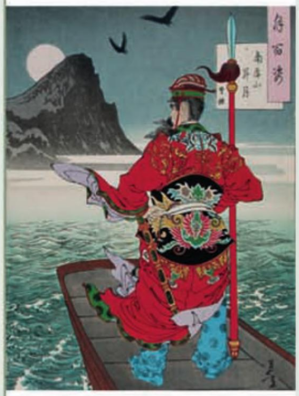

Characteristic concave-shaped iron head

KEY **BATTLE**

THE BATTLE OF RED CLIFFS

208CE

The Battle of the Red Cliffs marked the culmination of the struggle between the northern Chinese warlord Cao Cao and his southern rival Sun Quan. Although Cao Cao lost, his fleet destroyed by fire, he escaped and continued to rule the northern kingdom of Wei.



▲ The warlord Cao Cao arrives by barge on the eve of the Battle of the Red Cliffs.

KEY DEVELOPMENT

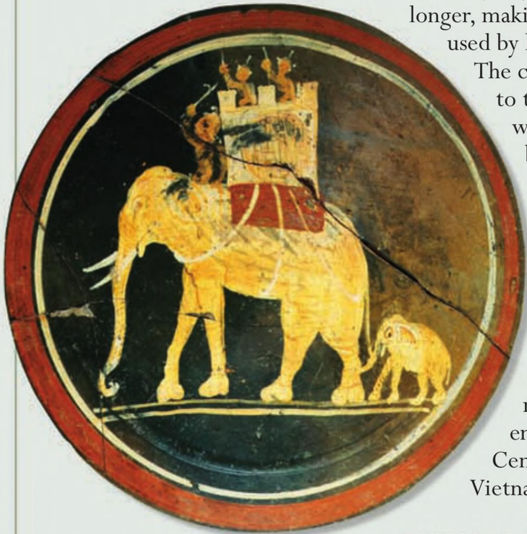
ASIAN TRADITIONS

Asian societies, in particular India and China, had their own distinctive military traditions. From the 6th century BCE onwards, large states began to appear in these areas that were able to deploy massive armies. In both China and India, however, these armies struggled to subdue nomads from Central Asia.

From the earliest times, China was the backdrop to fierce disputes between warring factions. The royal workshops of the Shang, the first historic Chinese Dynasty (1766–1122BCE), produced bronze dagger-axes, arrowheads, helmets, and shields, and early chronicles record battles against an enemy from the north called the "Tufang", with forces that numbered up to 5,000. Army sizes increased under the succeeding Western Zhou dynasty, but it was not until a period of political fragmentation known as the Spring and Autumn period (776–403BCE) that more organized military activity began.

Spring and Autumn armies combined chariots, ridden by noble warriors armed with bows, with infantry who fought with lances. This era gave way to the Warring States period (403–221BCE), a time of incessant warfare between rival powers such as Zhao, Qi, and Qin. As armies of up to 100,000 men fought in the battles between rulers, a shift occurred in favour of infantry-based armies, while traditional weapons such as the lance (*mao*) and dagger-axe (*ge*) became longer, making them more effective when used by large numbers of troops.

The crossbow appeared, adding range to the armies' destructive power, while military organization also became more sophisticated, with the publication of the first work on military strategy, by Sunzi, in around 500BCE. After China became united under the Qin in 221BCE, its successor dynasty, the Han, was able to call on even greater military resources, with a war tax and a pool of recruits of up to a million enabling campaigns deep into Central Asia and as far afield as Vietnam (in 111BCE).



▲ ELEPHANTS AT WAR
War elephants are first mentioned in the Mahabharata around 1000BCE, and their use was subsequently adopted by Alexander the Great. Many other armies, such as Hannibal's Carthaginians, also employed them.

STRUGGLES IN INDIA

The earliest archaeological indications of warfare in India come from the Indus Valley civilization, where arrowheads and flat axes have been found in the ruined city of Mohenjo-Daro, dating towards the end of the 3rd millennium BCE. The India depicted in the Vedic poems (around 1500–1000BCE) had a similar aristocratic tradition to that of China, in which chariot-mounted nobles armed with bows were the most important military force. By the time of the era described in the epic poems, such as the Mahabharata (around 900BCE), warfare had become more varied, with larger numbers of infantry and the first appearance of swords. As early states coalesced after 600BCE, more realistic historical records begin to emerge, recounting, for example, the wars of Bimbisara and Ajatashastru of Maghada: in their struggle against the Vriji confederacy they are said to

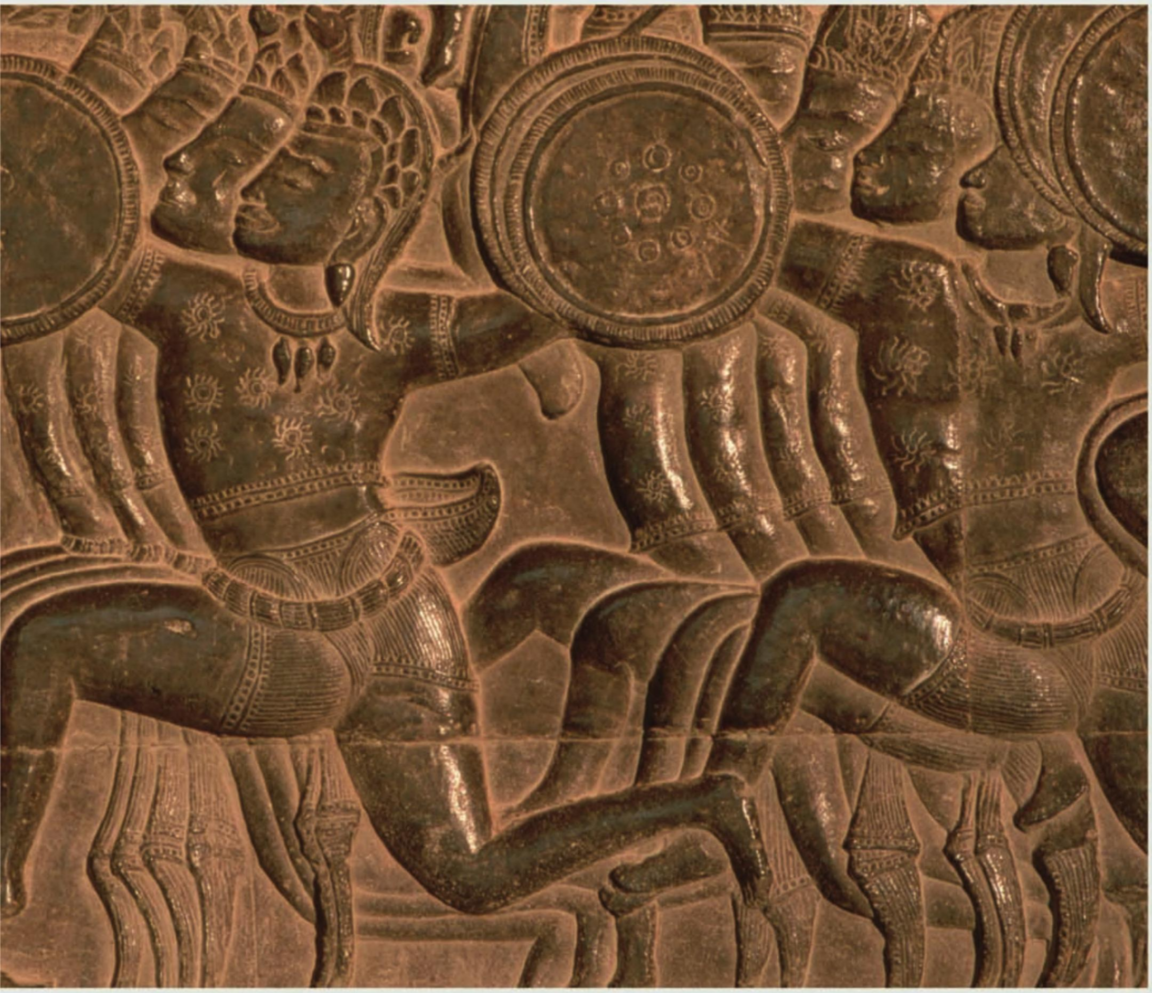
have used large catapults to hurl rocks, as well as the *rathamusala*, a chariot fitted with a mace that scythed through the enemy's ranks. From the early 5th century BCE, the empire-building Nanda dynasty could deploy armies consisting of 20,000 cavalry and 200,000 chariots, as well as 3,000 war elephants, which the Greeks encountered for the first time when Alexander the Great's army invaded India in 327BCE.

HORSEBACK RAIDERS

From the 2nd century BCE, Indian dynasties lost territory in the north of the country to Central Asian nomadic groups such as the Yuezhi, and later the Sakas and Hunas. Horse-mounted bowmen, these warriors could travel rapidly, enabling them to carry out successful campaigns of harassment against Indian forces of greater number. The established Asian powers, with their more conventional military tactics, found these offensives difficult to repel. In China, the Han engaged in a long-running struggle against the nomadic Xiongnu people to the north-west, who several times during the 2nd century BCE seized control of the strategic Tarim Basin. They and many other tribes continued to plague the Chinese along the whole frontier of their empire well into the 5th century CE.

▲ **TERRACOTTA ARCHER**
Often aristocratic warriors, archers formed the elite of Chinese armies, until the rise of elite infantry and weapons such as the crossbow, which occurred during the Warring States period (403–221BCE).

> "Let your rapidity be that of **the wind**, your compactness that of **the forest**. In raiding and plundering, **be like fire**"
>
> **SUNZI**, *THE ART OF WAR*, 500CE

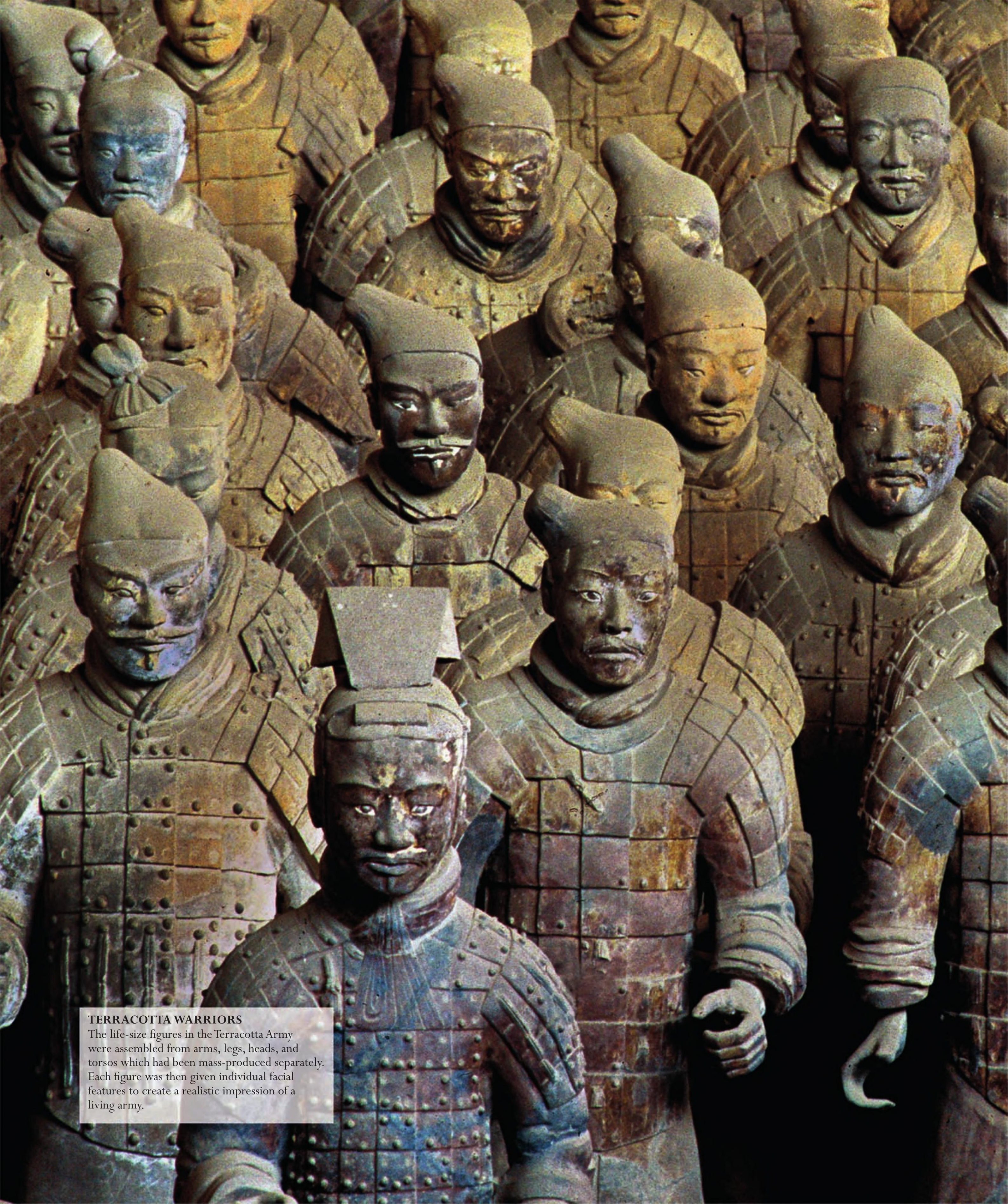


◀ **EPIC BATTLE**
A scene from the Mahabharata, an ancient Indian epic recounting a struggle between two armies over the Delhi area that ended in an 18-day battle.

KEY **EVENTS**

2600–100BCE

- **c.1000BCE** The legendary Mahabharata War between the Kauravas and Pandavas is the first conflict described in Indian history.
- **221BCE** After a long series of wars, the Qin kingdom under Qin Shih Huangdi conquers the last of the other Warring States, making China a unified country ruled by an emperor for the first time.
- **261BCE** Mauryan forces kill around 100,000 Kalingan soldiers in a bloody battle during the conquest of Kalinga (in modern Orissa, India). The victorious Mauryan ruler, Ashoka, renounces war and turns to the non-violent creed of Buddhism.
- **202BCE** At the Battle of Gaixia, the Chinese Han army under Liu Bang traps the rival Chu force under Xiang Yu in a canyon, killing most of them. Soon after, Chu surrenders, and Liu Bang becomes the first Han emperor.
- **127BCE** General Wei Qing invades the Xiongnu lands north of the Chinese frontier, beginning a Han–Xiongnu war that carries on intermittently until 89CE.



TERRACOTTA WARRIORS
The life-size figures in the Terracotta Army were assembled from arms, legs, heads, and torsos which had been mass-produced separately. Each figure was then given individual facial features to create a realistic impression of a living army.

AN ANCIENT CHINESE ARMY

TERRACOTTA WARRIORS

Discovered near Mount Li in Shaanxi Province in 1974, the buried collection of sculptures known as the Terracotta Army opens a unique window on China's military past, providing a realistic representation of an army in the reign of self-styled "First Emperor" Qin Shi Huang over 2,000 years ago.

A towering figure in Chinese history, Qin Shi Huang unified all of China under his rule in 221BCE, crushing his rivals by the relentless application of military power. As emperor he centralized power, suppressed dissent, and launched large-scale construction projects, including the first attempt to build a Great Wall to block the incursions of steppe nomads. The Terracotta Army was created as part of the emperor's burial complex: it comprises over 8,000 soldiers, 150 cavalry horses, and 130 chariots, each pulled by four horses.

The great majority of the army represented in these sculptures consists of peasant foot soldiers. They are depicted with armour of laced plates (the originals would have been made of bronze or hardened leather), and though helmets are not shown on the figures, archaeological finds of armour include them. The figures were also equipped with real weapons, fragments of which remain. Other sources reveal that infantrymen were equipped with a variety of bronze axes and swords, along with staff weapons, most typically the "dagger-axe". This was a long spear with a sharp blade attached to the haft, which could be used to stab in a prodding motion or wielded like a scythe. Many of the men also carried crossbows, a fundamental weapon in Chinese warfare: crossbows with sophisticated bronze trigger mechanisms were found during the excavation of the Terracotta Army.

Cavalry was a recent innovation that had helped Qin Shi Huang achieve his military ascendancy. With no native tradition of horsemanship, the Chinese had learned the importance of mounted troops from their wars with steppe nomads; some of the horsemen would have been armed with varieties of bow. The chariots represented a Western influence on Chinese armies; by this period, rather than being used as a shock force, on the battlefield they chiefly functioned as mobile command platforms for aristocrats and senior officers, kept to the rear of the fighting troops. Indeed, officers in the Terracotta Army are portrayed as taller than ordinary soldiers, and are also identifiable by their long double tunics and more elaborate armour.

SERRIED RANKS

The arrangement of the Terracotta Army in ordered ranks suggests a body of disciplined soldiers drilled to march in step. According to ancient texts, armies numbering hundreds of thousands of men were fielded in the largest Chinese battles. Even allowing for exaggeration, the massed peasant forces must have been large and difficult to command. Banners were used to signal messages across the battlefield, drums marked an advance, and bells were sounded to order a retreat. Crossbows were probably deployed in mass formations, with soldiers shooting volleys in sequence, one group loosing their bolts while another reloaded. An exchange of missiles at distance was probably more to the taste of poorly motivated peasant conscripts than close-quarters combat. The emphasis in ancient military writings on deception, rather than pitched battles, may well reflect the difficulty of executing decisive battlefield manoeuvres with unwieldy forces.

500–1500

KNIGHTS AND BOWMEN

INTRODUCTION

During the era known in Europe as the Middle Ages, warfare was dominated by the mounted warrior – from the armoured European knight to the steppe horseman. Military technology evolved slowly, and for a long time the bow was more influential than new gunpowder weapons.

Centres of settled civilization were often vulnerable to raids or conquest by marauding warrior tribes: despite being relatively advanced in terms of both technology and its government, China was conquered in the 1200s by the Mongols – steppe nomads using the composite bow. Religious zeal also proved as important as technological advantages: the foundation of Islam in around 600CE inspired an Arab expansionist drive, while, from around 1090, militant Christianity inspired crusades to Palestine and the retaking of Spain from Muslim rule. These insecure times saw the building of castles and other fortifications, which then became the object of attack by siege engines.

During this period, developments in metallurgy improved the quality of the steel used for swords and armour. In western Europe, the mounted knight, clad in increasingly complex armour, became a central figure in the culture of chivalry, as well as a highly effective fighting man.

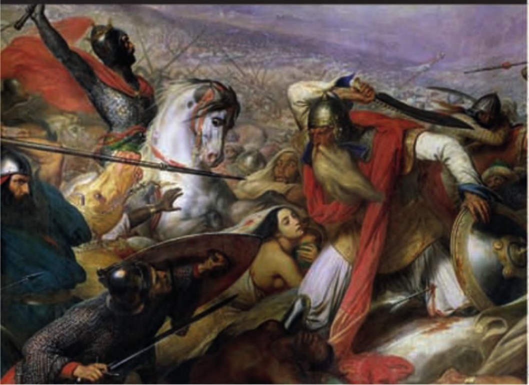
European warfare also repeatedly demonstrated the effectiveness of disciplined foot soldiers – from the Genoese crossbowmen, to the longbowmen of the English kings, to the Swiss with their pikes. The use of gunpowder also crept into warfare during this era – initially as a peripheral novelty, valued more for its surprise effect of flashes and bangs than for its practical impact. In 15th-century Europe, however, improvements in the construction of metal cannon, and in the quality of gunpowder, created the potential for a transformation in siege warfare and fortifications. Large guns had made the tall, stone walls of the medieval castle obsolete by 1500, but it would take considerably longer for the armoured knight to disappear from the battlefield.

KEY DATES

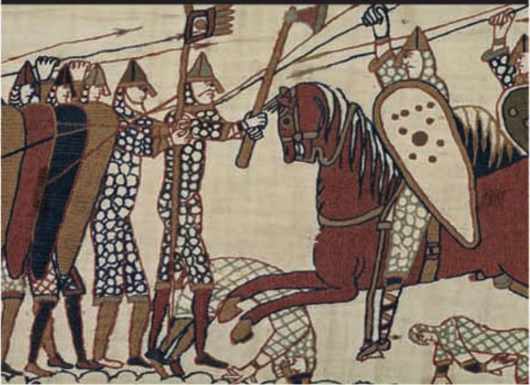
500

- **533** The Byzantine general Belisarius attempts to restore the Roman Empire in Italy and North Africa
- **632** A century of Arab conquests begins, extending from central Asia to Spain
- **672** Byzantines use the incendiary weapon "Greek fire" while defending Constantinople from Arab attack
- **732** The Franks, under Charles Martel, defeat a Muslim army near Tours, central France
- **793** Viking sea raiders sack the monastery at Lindisfarne, northern England
- **c.800** The use of the stirrup spreads from Asia to western Europe
- **900** Franks and Normans begin to fight on horseback using stirrups
- **955** The Magyars are defeated by European heavy cavalry at the Battle of Lechfeld, in Germany
- **c.1050** Gunpowder is first used in warfare, by the Chinese
- **1066** The Normans, under William, Duke of Normandy, defeat the Anglo-Saxons at the Battle of Hastings, in England
- **1096–99** European knights travel to Palestine and capture Jerusalem, in the First Crusade
- **c.1100** The counter-weight trebuchet is first used by the Byzantines as a siege engine
- **c.1132** The Song rulers of southern China establish a permanent navy
- **1156** Samurai clans begin civil wars in Japan
- **1187** Muslim warrior Saladin defeats a Crusader army at the Battle of Hattin, near Tiberias, in modern Israel
- **1206** Mongol leader, Genghis Khan, unites the steppe tribes and embarks on campaigns of conquest

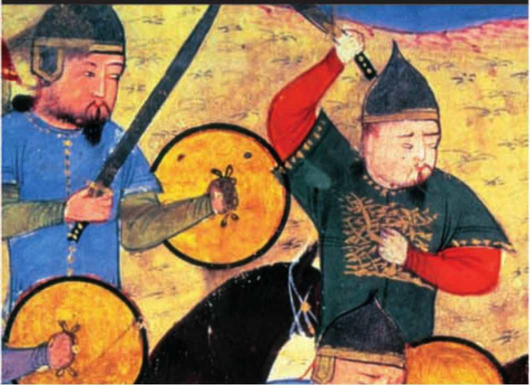
THE BATTLE OF POITIERS (TOURS) – 732



THE BATTLE OF HASTINGS – 1066



MONGOLS AT WAR – c.13TH CENTURY



1279 Mongol leader Kublai Khan completes the conquest of China

1281 The Japanese repulse a full-scale Mongol invasion

1291 The fall of Acre marks the end of the crusader kingdom

1302 French knights are defeated by Flemish infantry at the Battle of Courtrai, in western Flanders, Belgium

1324 The first recorded military use of cannon in Western Europe occurs at the Siege of Metz, in modern-day France

1346 Using massed longbows, English King Edward III defeats the French at the Battle of Crécy, in France

c.1380–1405 Timur, a central Asian leader, mounts campaigns of conquest from northern India to Turkey

c.1400 Most European knights wear plate armour as standard

c.1420 The use of corned powder improves the efficiency of gunpowder weapons

1421 The Hussites use gunpowder weapons on war wagons, at the Battle of Kutna Hora, Bohemia

1428 The Aztec Empire is founded in Mexico

1453 The French are victorious in the Hundred Years' War

1453 The Ottoman Turks capture Constantinople using heavy cannon

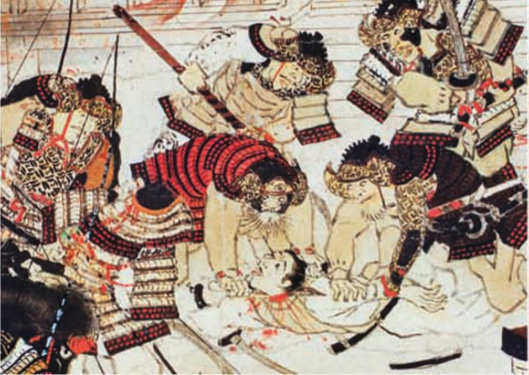
1474 In China, the Ming dynasty begins rebuilding the Great Walll

1476 A Swiss victory over the Burgundians at Murten proves the effectiveness of massed pikemen

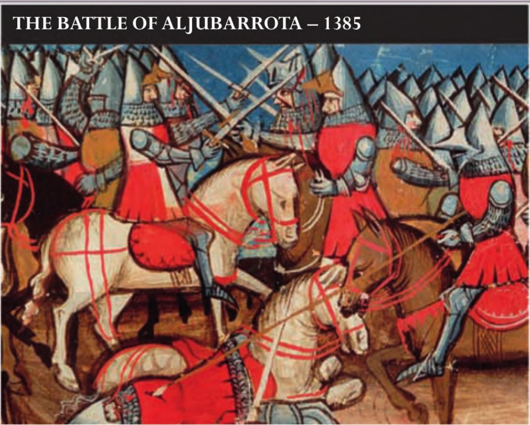
1494 King Charles VIII of France marches into Italy with an artillery train of cannon

1500

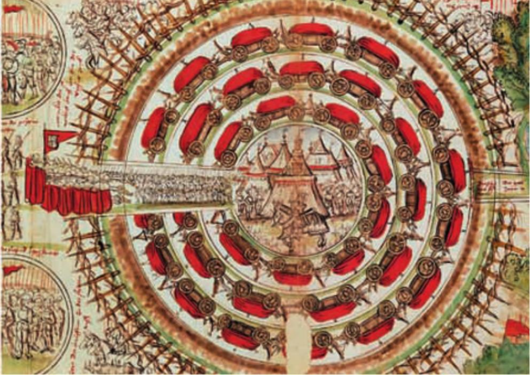
SAMURAI WARRIORS – c.13TH CENTURY



THE BATTLE OF ALJUBARROTA – 1385



HUSSITE WAGENBURGEN – c.15TH CENTURY



KEY DEVELOPMENT

THE WEAPONS OF EARLY MEDIEVAL EUROPE

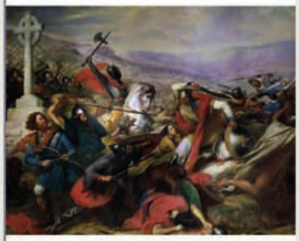
From 500CE to 1000, the relatively weak states of western Europe were prey for raiders. By the 11th century, however, the improved use of armoured cavalry in mounted combat was becoming a significant factor on the battlefield.

KEY **BATTLE**

BATTLE OF POITIERS (TOURS)

732CE

An army of Arab and Berber horsemen from Spain – an area recently conquered by the Muslims – invaded Frankish territory in 732CE. Charles Martel, leader of the Franks, confronted them between Tours and Poitiers. The Frankish warriors fought dismounted in a tightly-packed square, and held off the Muslims with sword, spear, and shield to win a famous defensive victory.



▲ Charles Martel rides a white horse in this fanciful 19th-century painting of a battle said to have saved Christendom from Muslim domination.

The fall of the Roman Empire in western Europe, in the 5th century CE, was followed by a general decline in political organization and technology. This was not true, however, of the Byzantine Empire, the successor to the Roman Empire in the east. Despite many setbacks, the Byzantine imperial system retained its resources and organization to field an impressive army, centred around heavily armoured cavalry, known as cataphracts. The empire also maintained a formidable navy, and even devised an advanced secret weapon: the flammable liquid known as Greek fire – a predecessor of napalm. Byzantine ships used pump-operated tubes in their prows to spray streams of flames at enemy vessels.

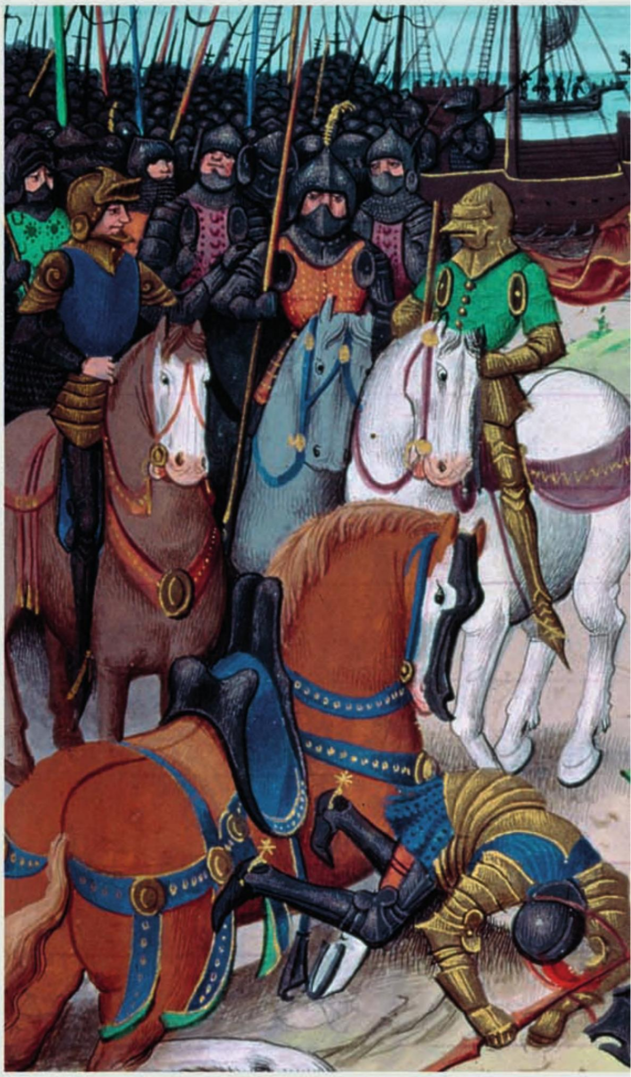
A CITIZEN MILITIA

Post-Roman western Europe, meanwhile, fell short of Byzantine sophistication. Even the kingdom of the Franks, the most prosperous successor state to the empire, at first had only a tribal warband for an army. By 800CE, under Charlemagne, the Franks ruled a large area of western Europe and, were bold enough to proclaim a Holy Roman Empire. However, they still lacked the resources to sustain permanent armed forces, instead depending on a system of obligation that required local lords, their followers, and levies (peasants and freemen) to turn up, fully equipped, for service. In Anglo-Saxon England, local lords or "thegns" assembled armed men from their districts as the "fyrd" – a part-time militia. Armed with swords, spears, and simple bows, and protected at best by mail armour, iron helmets, and shields, they were often unable to defend coasts or ill-defined land borders against a substantial hostile force.

THE RISE OF THE VIKINGS

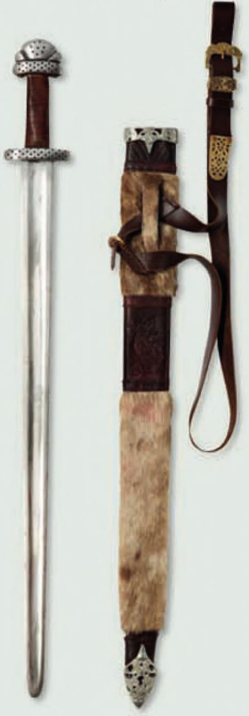
The Scandinavian Vikings first appear in European chronicles as seaborne raiders in late 700CE, using their longships to carry out hit-and-run attacks on coastal targets, and penetrating far inland along rivers. Later they became settlers and conquerors, ruling over much of the British Isles and part of northern France. Countermeasures against Viking raids were limited: the Franks built fortified bridges to block rivers; the Irish built tall towers as lookout posts; and the Anglo-Saxons created a network of fortified settlements – the "burhs". In battle, however, Viking axes and swords were a match for any technology available to the settled kingdoms.

Throughout the 10th and 11th centuries, a fresh dynamism emerged in western European warfare. Hardened, quenched steel was increasingly used for swords, crossbows began to appear, and motte-and-bailey castles were built – still made

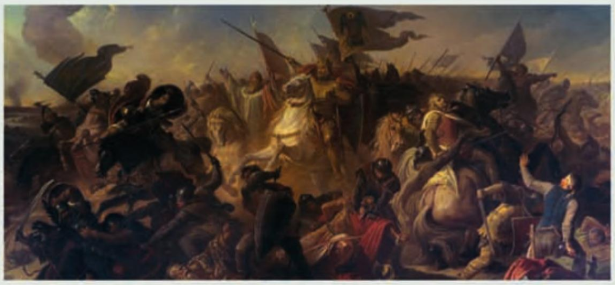


▼ VIKING SWORD

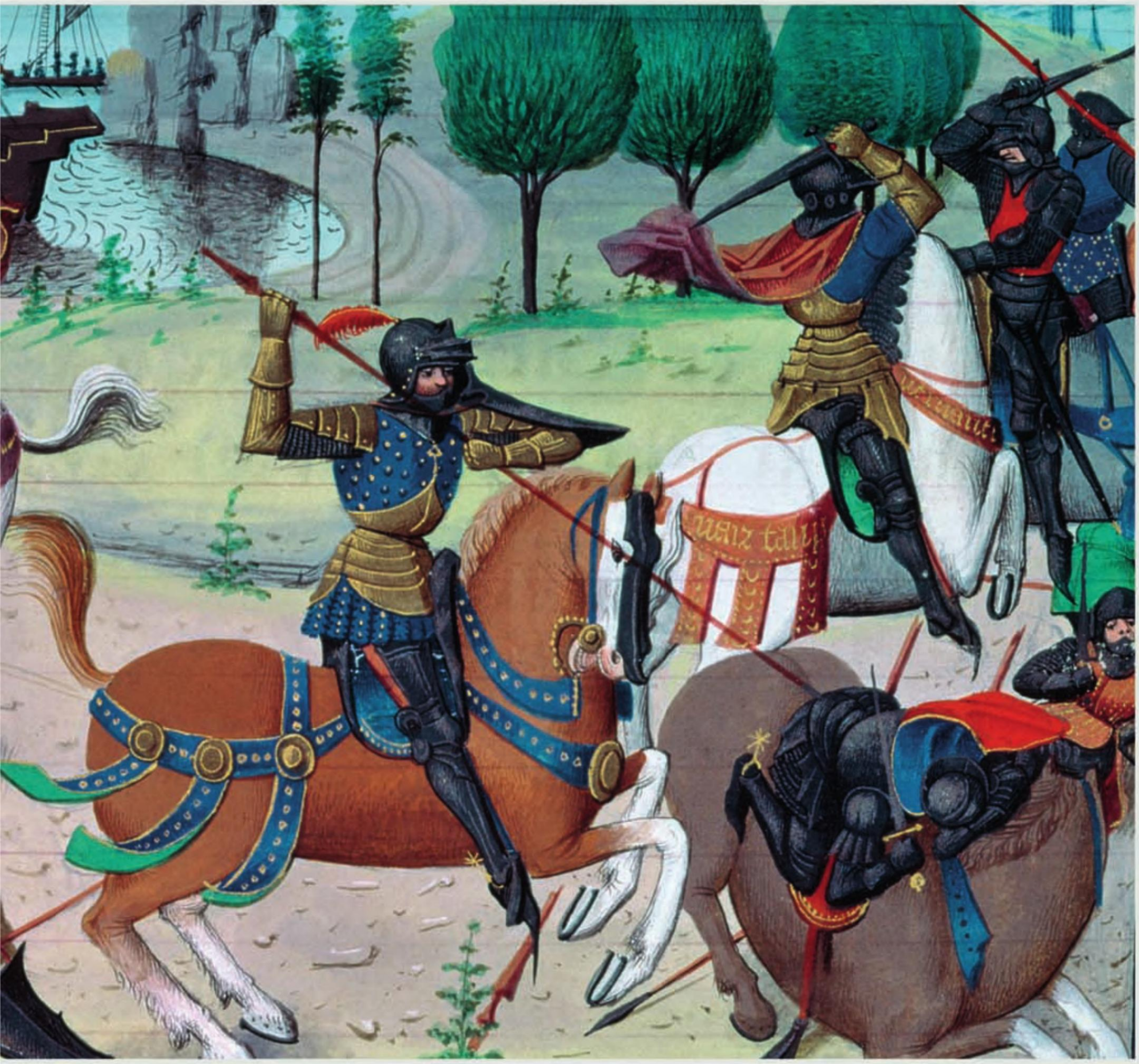
The seafaring Scandinavians known as Norsemen, or Vikings, were well-armed with swords, axes, shields, spears, javelins, and bows; some also wore mail armour. Some of their swords were pattern-welded for extra strength.



> "Shields, helmets and coats of mail were shivered by the **furious and impatient thrusts of his sword**; some he dashed to earth with his shield"
>
> **ORDERIC VITALIS**, ON WILLIAM THE CONQUEROR AT HASTINGS, c.1130CE



▲ THE BATTLE OF LECHFELD
In 955CE, at Lechfeld, European armoured horsemen led by Otto I defeated the previously invincible Magyars. The victory was achieved through a decisive cavalry charge, assisted by the use of stirrups.



◄ THE BATTLE OF HASTINGS
Following William, Duke of Normandy's invasion of England, Anglo-Saxon and Norman infantry and cavalry clashed at Hastings, in 1066.

of wood, but now featuring a keep on top of an earth mound as a central strongpoint. Until the 10th century, horsemen had mostly dismounted to fight, but the adoption in Europe of stirrups and of a saddle with a raised pommel and cantle (backrest) made the horse an effective fighting platform. The efficacy of mounted combat was demonstrated in 955CE, when Otto I of Germany defeated the Magyars by armoured cavalry charge. At first, mounted troops wielded spears overarm, as the Normans did against an Anglo-Saxon infantry shield wall at Hastings in 1066. However, fifteen years later, at the battle of Dyrrachium in southern Italy, Norman horseman could be seen charging with lances held underarm – a tactic that became the trademark of later medieval European warfare.

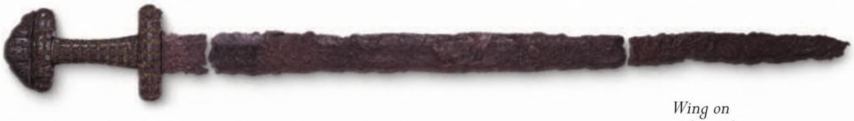
KEY **EVENTS**

500–1100

- ■ **From 533CE** Emperor Justinian tries and fails to restore the Roman Empire in North Africa and Italy; the eastern half of the empire becomes the Byzantine Empire.
- ■ **c.677CE** The Byzantines use the incendiary weapon known as "Greek fire" against Arab forces besieging Constantinople.
- ■ **752CE** Pepin the Short becomes the first Carolingian king of the Franks.
- ■ **793CE** Vikings use longships to cross the North Sea and plunder the monastery of Lindisfarne, in northern England, signalling the beginning of the period of Viking raids around the coasts of Europe.
- ■ **c.800CE** The Franks develop high-quality swords of hardened and tempered steel.
- ■ **800CE** Charlemagne, the Frankish king, is crowned Emperor of the Romans by Pope Leo III in Rome.
- ■ **900CE** Franks and Normans begin to fight on horseback, using the stirrup and improved saddles.
- ■ **911CE** Viking invaders form the Duchy of Normandy in northern France.
- ■ **1015–1026** Danish warrior, Canute, creates a North Sea empire, ruling England and Scandinavia.

VIKING WEAPONRY AND ARMOUR

The Vikings were warriors from Scandinavia who carried out raids across northwest Europe from about 800 to 1050CE, also reaching Russia, Iceland, and Greenland. Renowned as individual fighters, they defended from behind a wall of shields before emerging to strike their opponents. Their main weapon was an axe, though many also carried long, straight double-edged swords, while some brandished a single-edged, shorter version, the seax. Most were lightly armoured with leather or, occasionally, mail coats, and carried heavy shields.

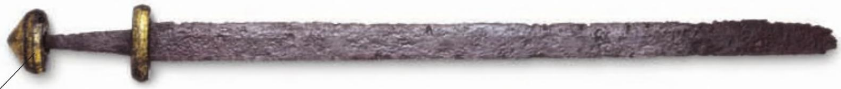


▲ PATTERN-WELDED SWORD

Date	700–800CE
Origin	Denmark
Weight	1.5kg (3¼lb)
Length	90cm (35in)

Many Viking swords, such as this one, were pattern-welded. This process involves adding carbon to red-hot iron and a number of rods, which are twisted together and hammered flat repeatedly to give a patterned appearance.

Wing on either side

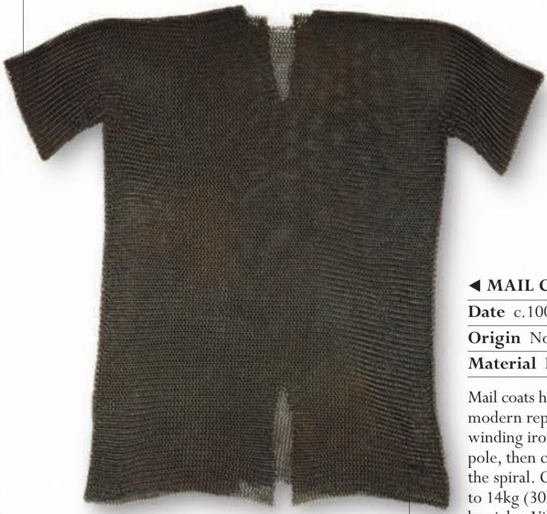


Large, decorated pommel

▲ DOUBLE-EDGED SWORD

Date	800–1100CE
Origin	Denmark
Weight	1.5kg (3¼lb)
Length	90cm (35in)

This blade, like most Viking swords, is quite blunt at the tip, as it was used for slashing and cutting rather than stabbing. The fuller – a groove that runs the length of the sword – makes it lighter and easier to use.



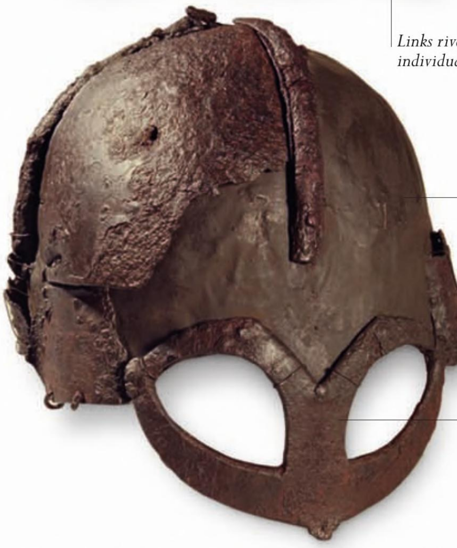
Short sleeve allows arm to move freely

Links riveted individually

◀ MAIL COAT

Date	c.1000CE
Origin	Northern Europe
Material	Iron

Mail coats had iron links – as visible on this modern replica – that were formed by winding iron wire tightly around a metal pole, then clipping individual coils from the spiral. Coats of mail could weigh up to 14kg (30lb) and were usually only worn by richer Vikings.



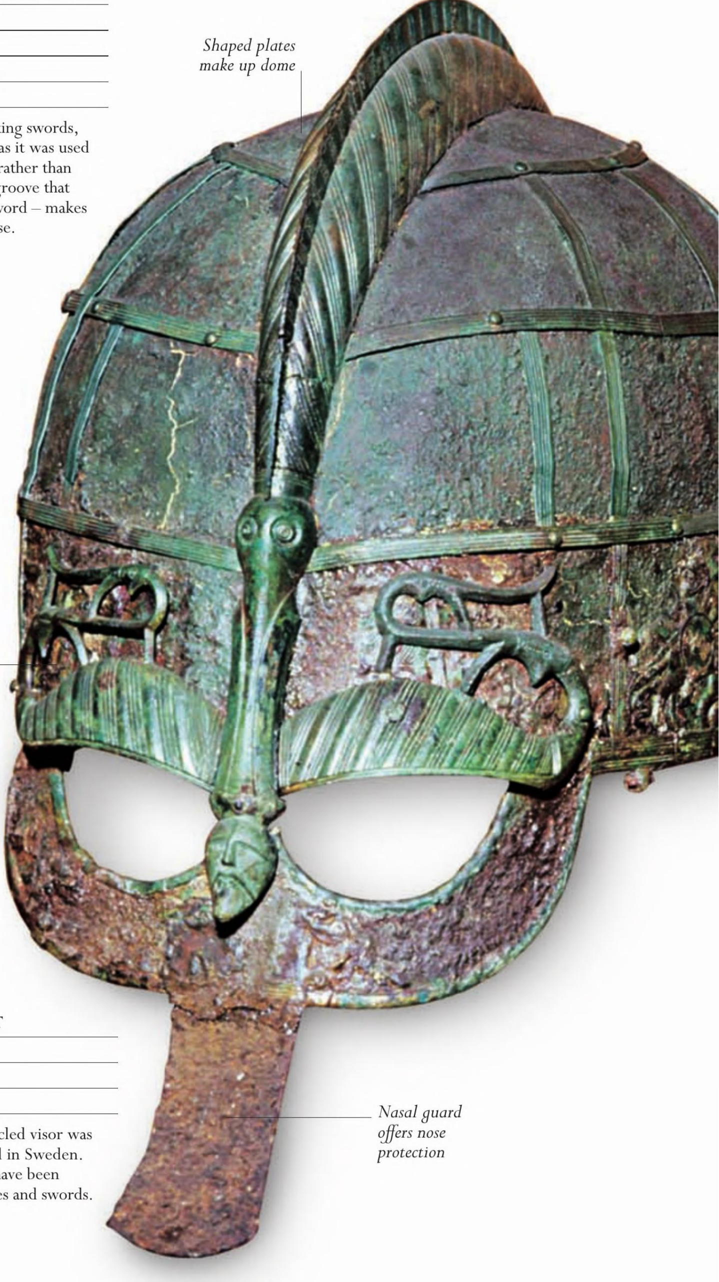
Dome composed of four plates

Spectacled visor protects eyes and nose

▲ GJERMUNDBU HELMET

Date	c.875CE
Origin	Norway
Material	Iron

Made from four iron plates, this helmet was found near Gjermundbu in Norway, in 1943. It is thought to have been used by Norsemen in the Viking Period.



Shaped plates make up dome

Animal decoration

Nasal guard offers nose protection

▶ SWEDISH HELMET

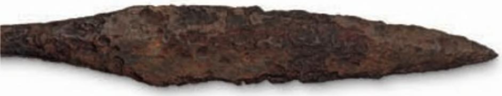
Date	700–800CE
Origin	Sweden
Material	Iron

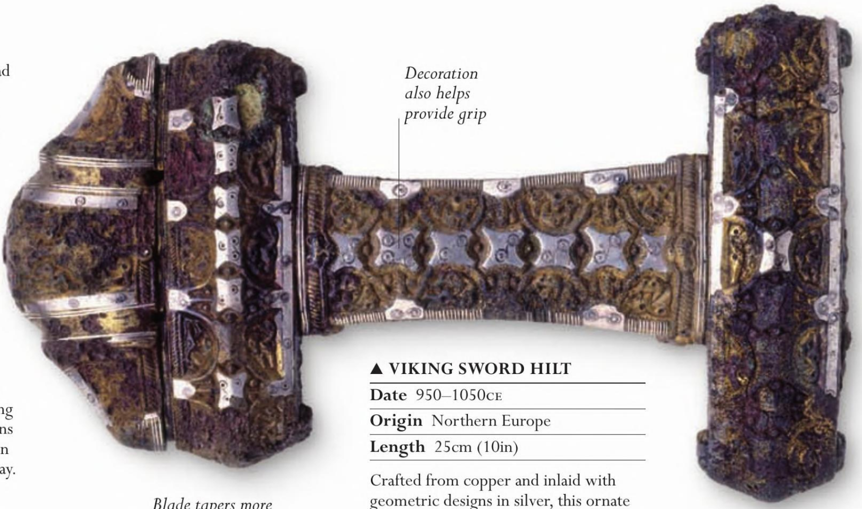
This helmet with a spectacled visor was found in a grave at Vendel in Sweden. Very few Viking helmets have been found, compared with axes and swords.

▼ WINGED SPEARHEAD

Date 700–800CE
Origin Northern Europe
Length 47cm (18½in)

This lugged or "winged" iron spearhead has a leaf-shaped blade and a tapered iron socket. The wings could prevent the spear blade from getting stuck in an opponent's body or hook a shield out of the way.




Decoration also helps provide grip

▲ VIKING SWORD HILT

Date 950–1050CE
Origin Northern Europe
Length 25cm (10in)

Crafted from copper and inlaid with geometric designs in silver, this ornate hilt was too fine to be used in battle, and probably belonged to a chieftain.

▼ LATE VIKING SWORD

Date 900–1000CE
Origin Northern Europe
Weight 1.5kg (3¼lb)
Length 80–100cm (32–39in)

As with most swords found on archaeological sites, this later Viking sword blade is badly corroded, making the interpretation of runic inscriptions on the blade very difficult. Its wooden scabbard and hilt have also rotted away.

Blade tapers more towards the point

Two-edged pattern-welded blade

▲ STRAIGHT-SIDED SWORD

Date 900–1000CE
Origin Scandinavia
Weight 1.5kg (3¼lb)
Length 90cm (35in)

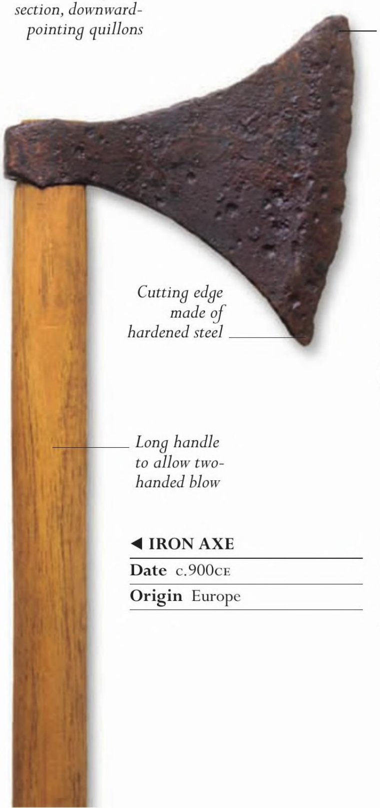
The sword shown here is typical of Viking weapons, which were mostly straight-sided and of about the same size, with a simple cross-guard and pommel. Its blade is inlaid with a figure-of-eight mark.

▼ TAPERED SWORD

Date 900–1100CE
Origin Scandinavia
Weight 1.5kg (3¼lb)
Length 90cm (35in)

This broad, straight, two-edged blade retains traces of an inlaid inscription – now indecipherable – and a scroll-design pommel, but its grip is missing. The sword is more tapered than earlier versions.

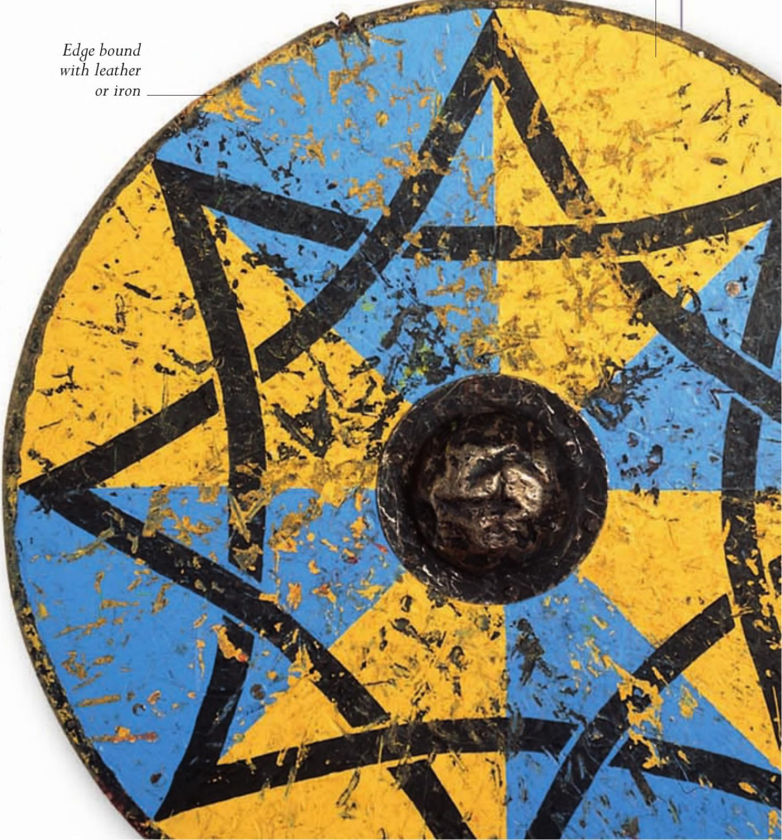
Fuller to lighten blade
Thick, square-section, downward-pointing quillons


Broad, crescent-shaped blade
Cutting edge made of hardened steel
Long handle to allow two-handed blow

◀ IRON AXE

Date c.900CE
Origin Europe

The example shown here is one of the three forms of Viking axe, the "bearded" axe. Its elongated lower edge and slanting blade were suited for downward blows.


Brightly painted pattern
Edge bound with leather or iron

▶ PAINTED WOODEN SHIELD

Date 900–1000CE
Origin Northern Europe
Weight 5kg (11lb)
Diameter 70–100cm (28–39in)

Viking shields were made from wood and covered with leather. They had an iron boss in the centre, which could be used for striking opponents. This example is a modern replica.

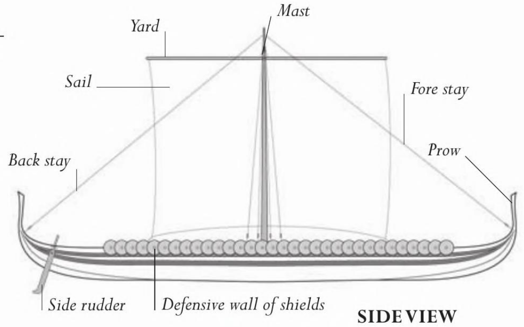
VIKING LONGSHIP

HAVHINGSTEN FRA GLENDALOUGH

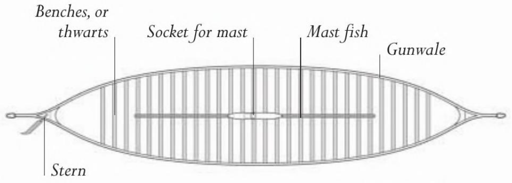
The Viking longship was a swift, sturdy, and versatile naval craft. Propelled either by a sail or by oars, it was one of the fastest vessels of its era, and able to travel great distances on the open sea.

A longship's shallow draught enabled it to penetrate far upriver or beach itself at speed in an early form of amphibious assault. It could also be hauled over narrow necks of land between waterways. The warriors it carried mostly took part in land raids, but occasionally crude sea battles took place involving exchanges of missiles and boarding with hand weapons.

The longship shown here, *Havhingsten fra Glendalough* (Sea Stallion from Glendalough), is a reconstruction of a vessel excavated from Roskilde Fjord, Denmark, that was built around 1042. As far as possible, the reconstruction used the techniques, tools, and materials of the Viking age, including timber from 300 oak trees. Steered by a side rudder, the longship has a strong keel and a high, curving prow and stern. It is clinker-built, meaning that its hull is made of overlapping planks, or "strakes", held together with iron nails. About 60 oarsmen – who doubled up as warriors on raids – would have rowed such a ship. Their muscle power could have delivered a steady speed of 5–6 knots, but with its sail raised and a favourable wind, a longship could probably have made up to 17 knots.



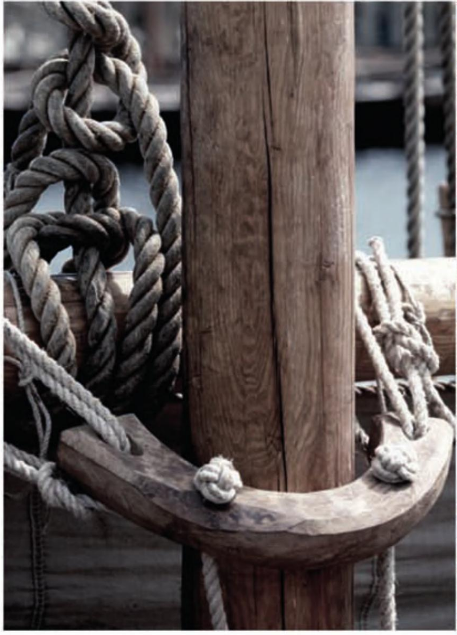
SIDE VIEW



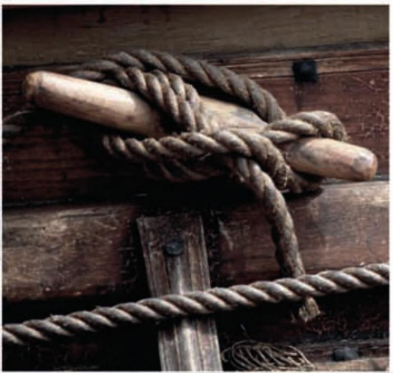
PLAN VIEW

▲ LONGSHIP PROFILE
The *Havhingsten* is about 30m (98ft) long but only 3.8m (12½ft) wide. This long, narrow shape makes it fast and enables it to sail in water less than 1m (3¼ft) deep.

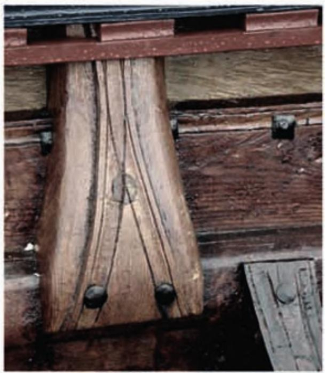
LONGSHIP STRUCTURE



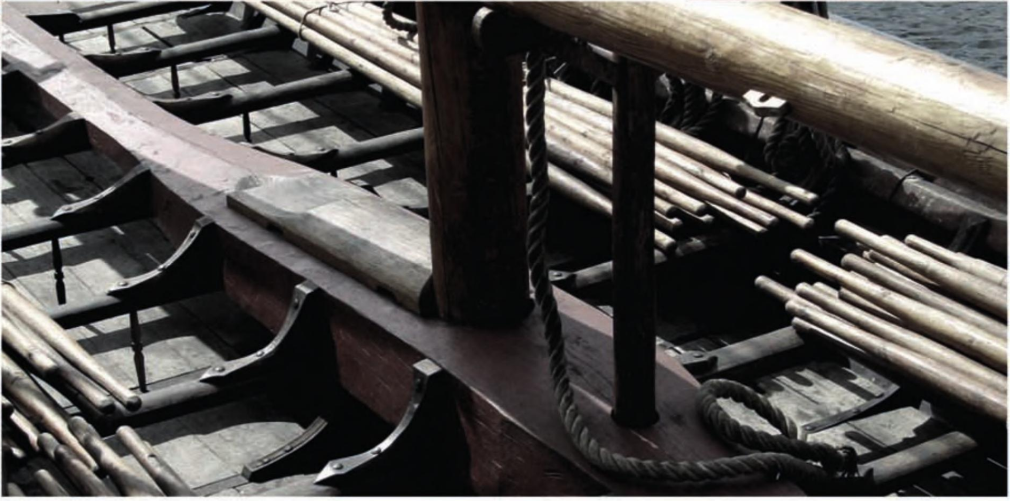
▲ PARREL
Attached by ropes, a horseshoe-shaped piece of wood known as a parrel held the yard onto the mast. Viking ship ropes were typically made of plant or animal fibres.



◄ CLEAT
The ropes that controlled the sail and the yard (the mast's horizontal wooden spar) were fastened to fixtures called cleats along the hull.



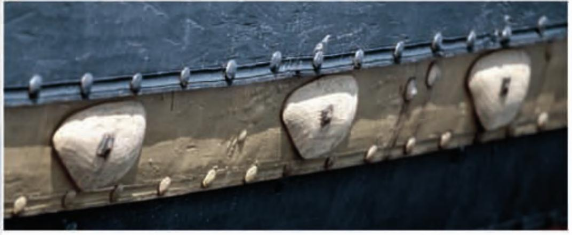
► STRENGTHENING TIMBER
Vertical timbers called top-ribs reinforced the hull's upper structure. They were butted into the gunwale and extended down over the first three strakes, to which they were secured with iron nails.



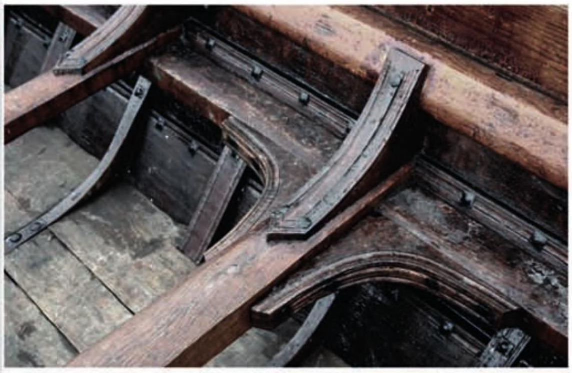
► MAST AND MAST FISH
The mast fitted into a socket in a block of wood called the kelson at the bottom of the boat. It was then secured in place by a horizontal piece of timber on the deck known as a mast fish.

OARS AND OARSMEN

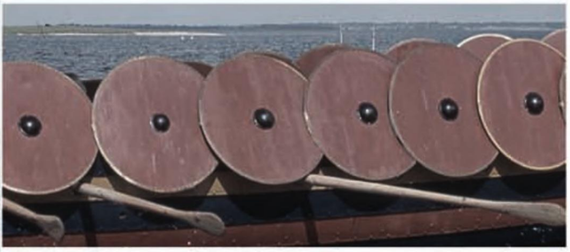
◄ PILE OF OARS
The *Havhingsten*'s oars measure 4.5m (15ft) long and their blades are 15cm (6in) wide. Research has shown that this is the most effective blade width for rowing long distances at sea.



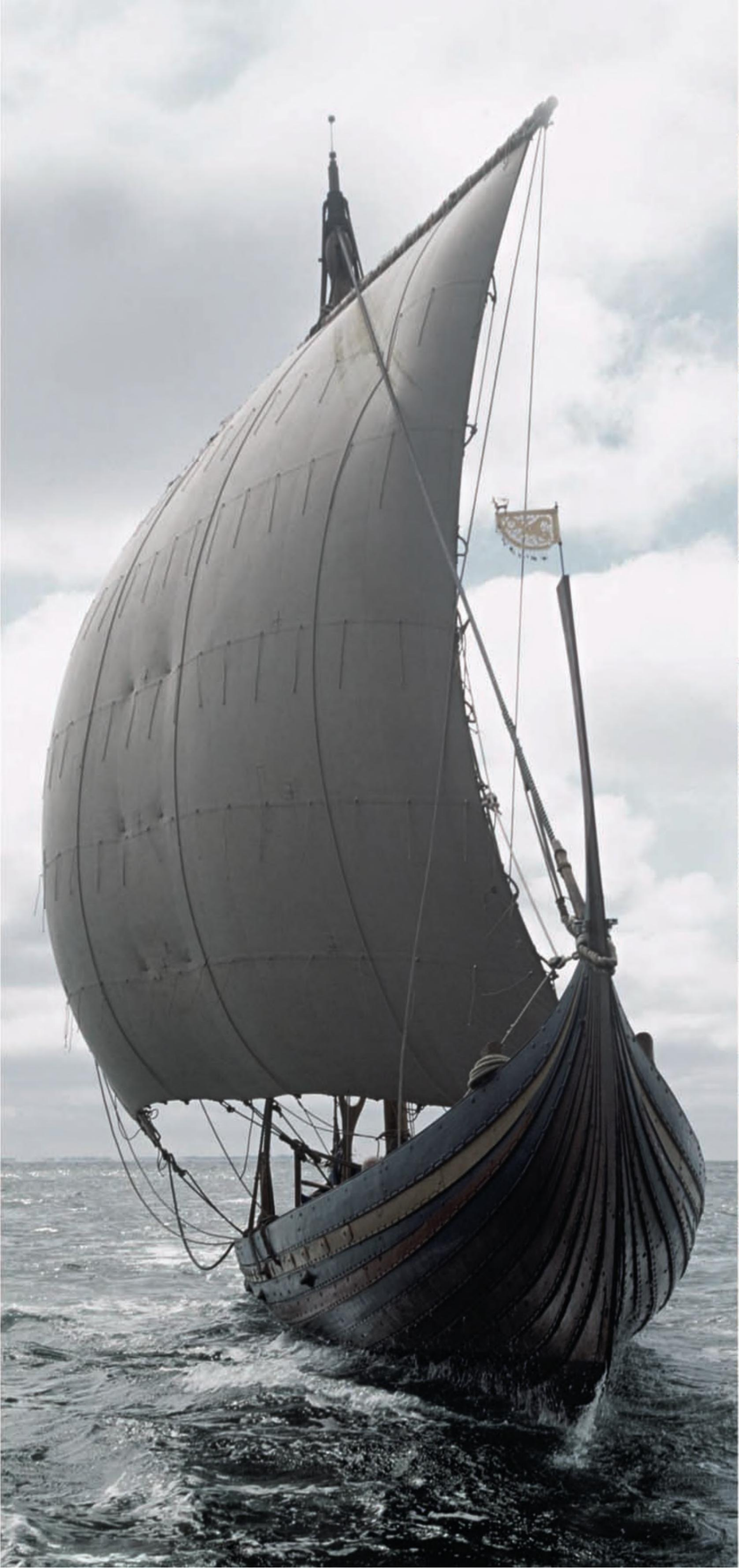
▲ OAR PORTS
The ports were large enough for the oar blades to pass through. When the ship was under sail and the oars were not in use, the ports were sealed with special locks.



▲ SEATING FOR OARSMEN
Although the benches were narrow, they allowed the oarsmen to shift position regularly on long journeys. Sometimes the rowers simply sat on sea chests instead of benches.



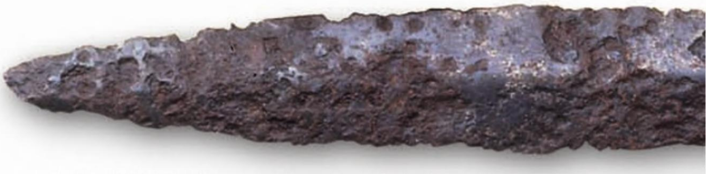
▲ ROWING FOR THE SHORE
As they neared a hostile shore, Viking warriors fixed their shields to the gunwale to create an impressive display and to deflect spears and arrows.



◄ SHIP UNDER SAIL
On the open ocean, Viking sailors relied on a large, rectangular sail. When manoeuvring in coastal waters and up rivers, they dropped sail and rowed.

ANGLO-SAXONS AND NORMANS

The term Anglo-Saxon is used to refer to the various Germanic tribes who invaded and occupied the British Isles from the mid-5th century CE. They were mainly infantry fighters, armed with spears and short fighting knives (*seaxes*), although their elite troops had elaborate armour and fine pattern-welded swords. Originally a Viking group from Scandinavia, the Normans were established in northern France from 911CE. They conquered Sicily and parts of southern Italy by the early 11th century, and invaded England in 1066. Their army contained a larger number of mounted warriors than the Anglo-Saxons, and also made effective use of archers.



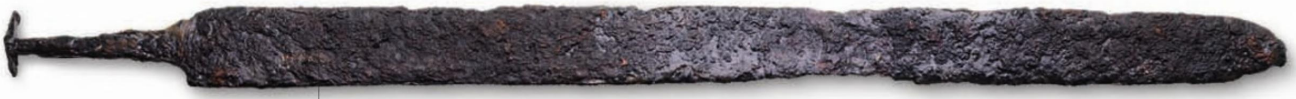
▲ LONG SAXON SPEAR

Date 400–500CE

Origin Northern Europe

Length 48cm (19in)

The spear was the Anglo-Saxon warrior's primary weapon. Many had long, leaf-shaped blades and wooden shafts traditionally made from ash. The warriors used the spears mainly with one hand, while holding a shield with the other.



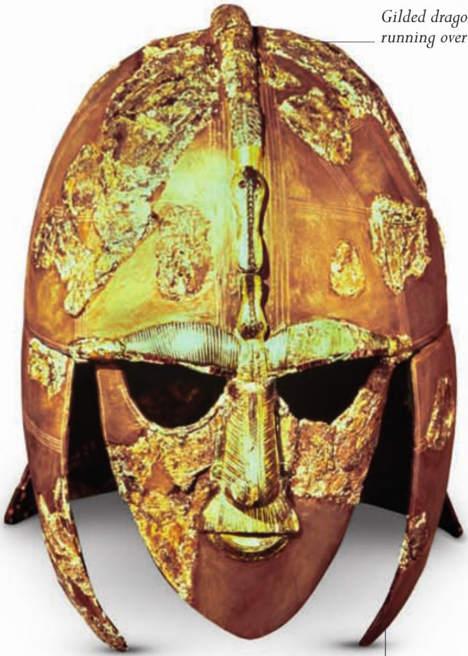
▲ ANGLO-SAXON SWORD

Date 500–600CE

Origin England

Length 1.05m (3½ft)

Anglo-Saxon swords were designed to inflict cutting blows, most often to the neck – which was usually fatal – or to the leg or sword arm, thus disabling the opponent. Their scabbards were attached to the wearer's belt by a loop.



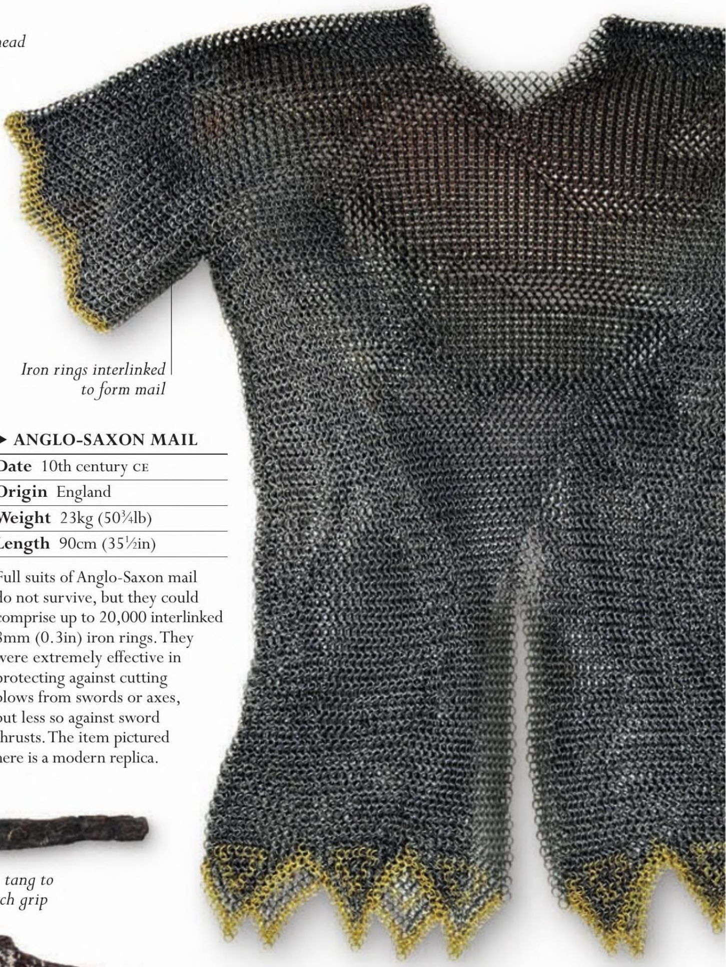
▶ SUTTON HOO HELMET

Date c.625CE

Origin England

Material Tin, bronze, silver

Found in the royal ship burial at Sutton Hoo in England, this is one of the most elaborate Germanic helmets to have survived. Its cheekpiece, facemask, and neck guard are decorated with tinned bronze foil pieces.



▶ ANGLO-SAXON MAIL

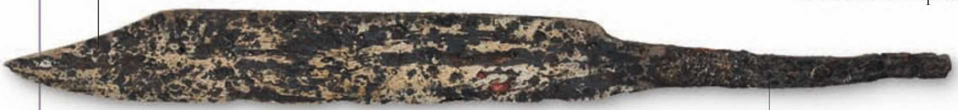
Date 10th century CE

Origin England

Weight 23kg (50¾lb)

Length 90cm (35½in)

Full suits of Anglo-Saxon mail do not survive, but they could comprise up to 20,000 interlinked 8mm (0.3in) iron rings. They were extremely effective in protecting against cutting blows from swords or axes, but less so against sword thrusts. The item pictured here is a modern replica.



▲ LONG SAXON KNIFE

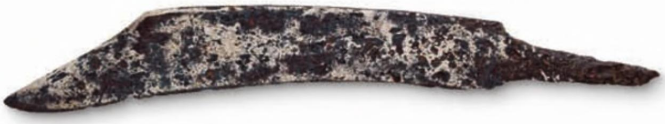
Date 600–1000CE

Origin Northern Europe

Weight 60g (2oz)

Length 24.76cm (9¾in)

The Saxon *seax*, a single-bladed knife, was as much a domestic implement as a weapon of war. A piece of wood or bone would have been attached to the tang to form a grip, but does not survive in this example.



▲ SHORT SAXON KNIFE

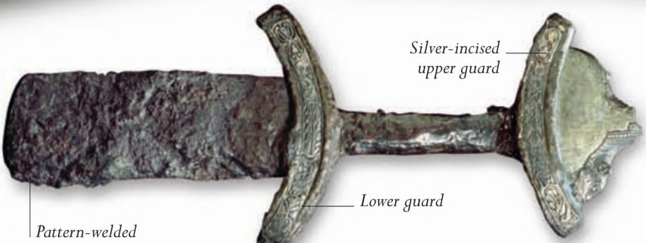
Date 600–1000CE

Origin Northern Europe

Weight 60g (2oz)

Length 19cm (7½in)

Most Saxon fighting knives, or *seaxes,* were made by twisting and hammer-welding hot bars of iron and steel – a process called pattern-welding – to produce a sharp, durable blade.


Silver-incised upper guard
Lower guard
Pattern-welded blade stump

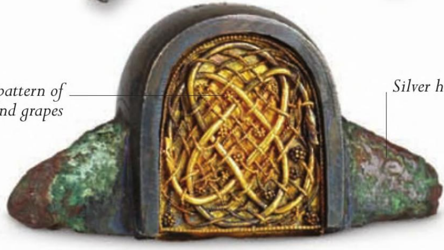
◀ LATE ANGLO-SAXON SWORD

Date 900–1050CE

Origin England

Length (Surviving) 50cm (19¾in)

This pattern-welded sword's blade is mostly broken off, and its upper and lower guards curve in opposite directions. Anglo-Saxon swords were balanced around halfway down the blade, making them better adapted for cutting strokes.


Interlacing pattern of snakes and grapes
Silver hilt

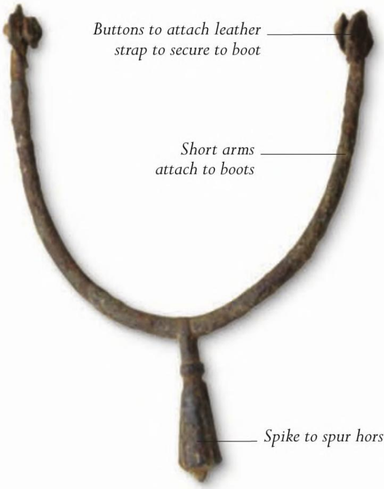
▲ DECORATED ANGLO-SAXON SWORD HILT

Date Mid-8th century CE

Origin England

Material Silver, gold filigree

This ornate early Anglo-Saxon sword has an intricate gold-filigree pommel with interlaced snakes and grapes against a vine pattern. It would have belonged to a high-status warrior or noble.


Buttons to attach leather strap to secure to boot
Short arms attach to boots
Spike to spur horse

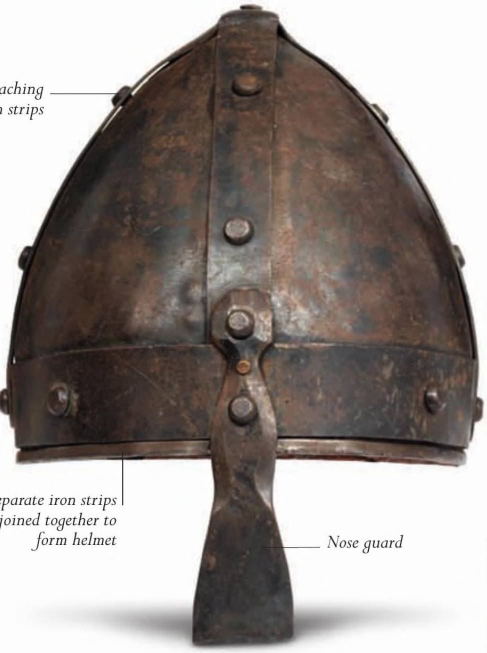
◀ NORMAN SPUR

Date 11th century

Origin England

Material Iron

Knights riding on horseback played a key role in Norman armies. The riding boots of these warriors were equipped with spurs with spiked ends to help direct the horses.


Rivets for attaching iron strips
Separate iron strips joined together to form helmet
Nose guard

▶ NORMAN HELMET

Date 11th century CE

Origin England or northern France

Material Iron

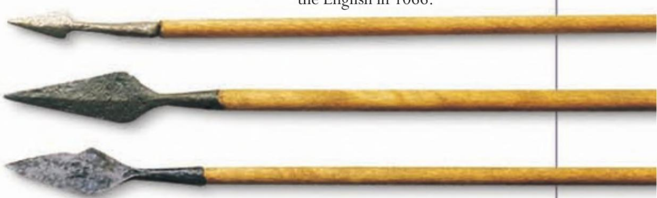
Norman warriors wore conical metal helmets, much like earlier medieval *Spangenhelms*. Norman helmets, however, also featured a long, thin nose guard for better facial protection.

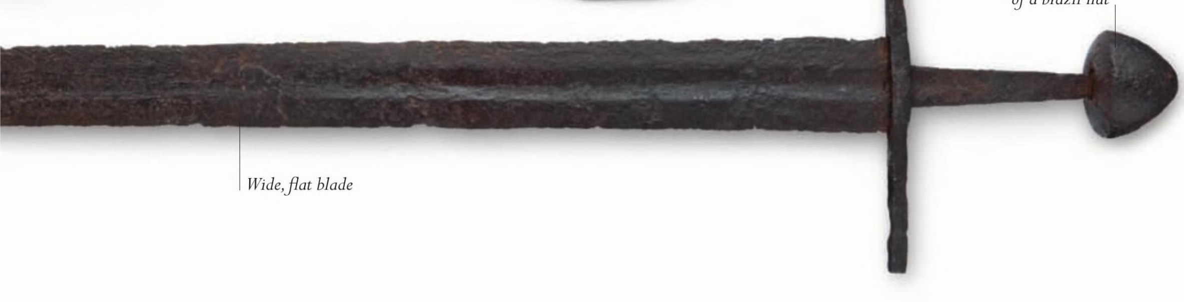
▼ NORMAN ARROWS

Date 11th–12th century CE

Origin England

The narrow, pointed heads of Norman arrows were designed to penetrate mail. Despite their effectiveness on the battlefield, however, arrows were little used by the Normans before the Battle of Hastings against the English in 1066.




Pommel in the shape of a brazil nut
Wide, flat blade

◀ NORMAN SWORD

Date c.1100

Origin England

Weight 1.28kg (2¾lb)

Length 96.5cm (38in)

Norman swords generally had brazil-nut-shaped pommels, long, flat cross-guards, and a broad, flat blade that was adapted for use both from horseback and on foot.

DARK AGES INVASION FORCE

THE BATTLE OF HASTINGS

The victory of William of Normandy over the Anglo-Saxon King Harold II at the Battle of Hastings on 14 October 1066 was a turning point in English history. It was a close-fought battle in which the Anglo-Saxons narrowly failed to hold their ground against Norman cavalry and bowmen.

The death of Anglo-Saxon King Edward the Confessor in January 1066 triggered a succession struggle. Harold Godwinson, Earl of Wessex, was crowned king, but his right to the throne was contested by his brother Tostig and by William, Duke of Normandy. William immediately began assembling an invasion fleet at Dives-sur-Mer on the Normandy coast. By August he was ready to sail, but was prevented by the winds, which fortunately worked in his favour. Having stood ready to face an invasion all summer, Harold's peasant army, the fyrd, had to be released to gather the harvest. Meanwhile Tostig had sought the aid of King Harald Hardrada of Norway, and in September Harald led his own invasion force across the North Sea. With his personal troops, the housecarls, and hastily raised levies, Harold marched north to defeat Harald at the Battle of Stamford Bridge. This left England's southern coast undefended.

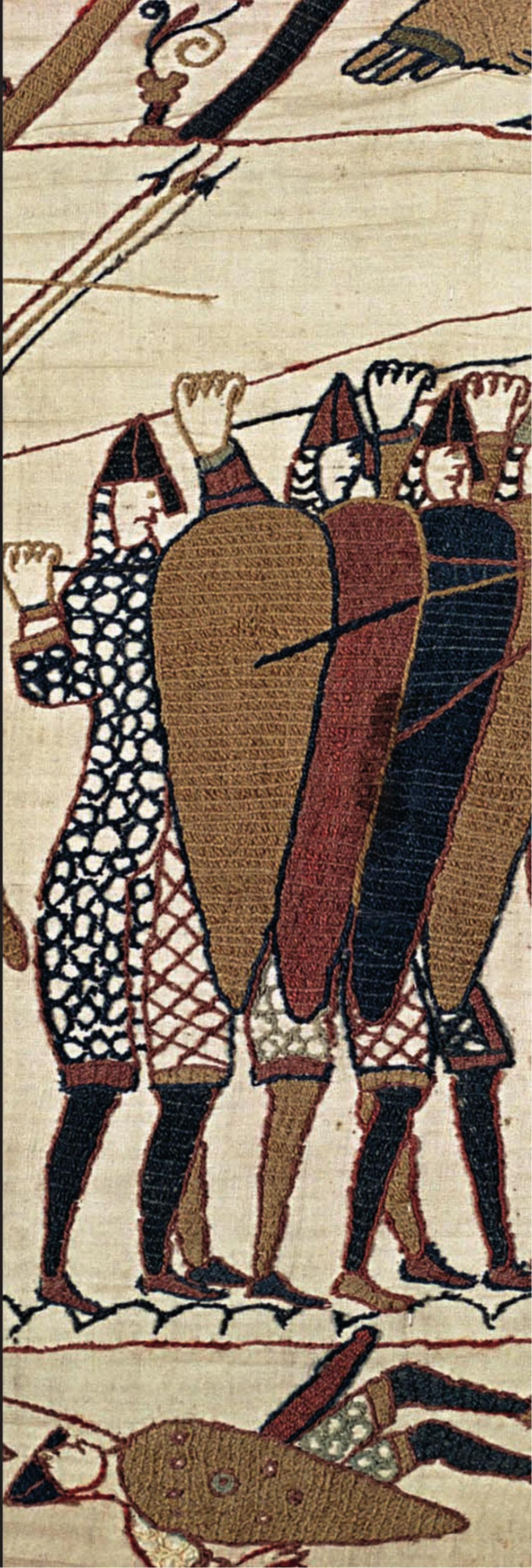
NORMAN INVASION

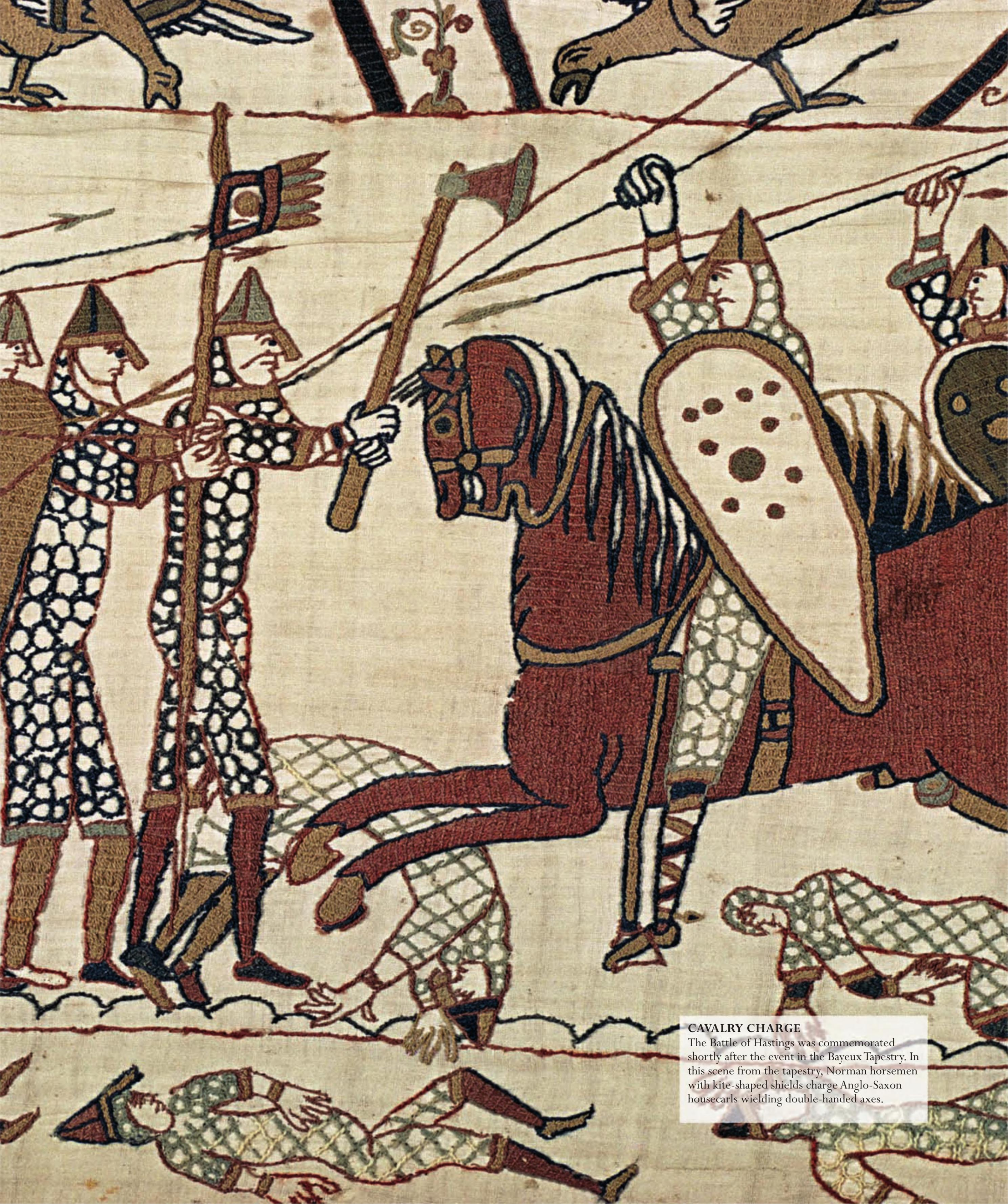
William sailed across the Channel, his soldiers and horses packed into 700 vessels, and landed unopposed at Pevensey in Sussex. He advanced along the coast to Hastings, while Harold hurried his army southward. On 13 October, William learned that the Anglo-Saxons were nearby, and the following morning he led his army out to meet them.

The strength of both forces is uncertain – estimates vary from a few thousand to tens of thousands on each side. Harold had taken up a strong defensive position on top of Senlac Ridge. His men were exhausted after the long journey from the north, but resolute. They would fight on foot, clustered together in close formation, wielding two-handed axes or spears and depending on the protection of their shields and armour. William had a mixed force of infantry and cavalry at his disposal: they would have to attack uphill, but hoped to break up the tightknit Anglo-Saxon formation with the impact of their arrows and cavalry charges.

THE LUCK OF THE DAY

The Norman bowmen opened the battle, attempting to soften up the enemy with their mix of simple bows and a few crossbows. Then the armoured infantry advanced uphill, the horsemen following behind. But the Anglo-Saxons stood firm as the Normans assailed their shield wall, bringing the attack to a halt. William was in the heart of the action. When some of his men began to fall back in disarray, the Norman leader reportedly pulled off his helmet to show his face and called out for them to renew their efforts. Eventually, in the turmoil of combat, some Anglo-Saxons were tempted to rush forward in pursuit where they saw Normans apparently retreating. They were cut down in a Norman counterattack. As the Anglo-Saxon forces weakened and lost formation, Norman horsemen were able to penetrate their ranks, wreaking havoc. The Anglo-Saxon housecarls pulled back in a tightening circle around their king. Norman arrows continued to rain down on them and, tradition has it, Harold was among their victims. He was certainly killed (whether by an arrow in the eye, or not, is disputed), and by the day's end the Normans held the field.





CAVALRY CHARGE
The Battle of Hastings was commemorated shortly after the event in the Bayeux Tapestry. In this scene from the tapestry, Norman horsemen with kite-shaped shields charge Anglo-Saxon housecarls wielding double-handed axes.

KEY DEVELOPMENT

ARMOURED CAVALRY IN MEDIEVAL EUROPE

The armoured knight appeared as the key figure in western European warfare around the 11th–12th centuries. The armour and weaponry of this elite warrior evolved constantly in search of better protection and more effective attack.

Heavily armoured cavalry first developed in Asia, and reached Europe through the Roman Empire's contacts with Sassanid Persia from the 3rd century CE. As a result, the Byzantine Empire fielded cataphracts (early heavy cavalry) as its shock battlefield force. Both the cataphract and his horse were fully covered by scale armour, which was made of overlapping metal plates. His main weapon was a long lance. Sustaining such a warrior required a supply of purpose-bred large horses, skilled metalworkers, and the resources to pay for these.

DEVELOPMENTS IN ARMOUR

Cavalry in western Europe evolved independently, but was influenced by the Byzantine example. Mounted forces had adopted the lance by the 12th century, but their armour was still relatively primitive. A coat of mail, the hauberk, covered the body, while the head was protected by a mail hood and conical iron helm, the face exposed except for a "nasal", a central metal guard covering the nose. The cylindrical great helm completely enclosed the heads of the knights who fought for Richard the Lionheart on the Third Crusade in 1191–92, improving protection but sacrificing all-round vision and ease of breathing. Over the years, plate armour was added, first on the legs, arms, and shoulders. The great helm was superseded by the pointed basinet with a hinged visor.

By the 15th century, suits of full plate armour had come into general use. A well-made suit of armour, its weight well distributed, never prevented a knight mounting his horse unaided or fighting on foot: its main disadvantage was that it caused overheating. Both armour and helmets continued to evolve in terms of the skill of manufacture and complexity of design and decoration, reaching a pinnacle of elaboration in the 16th century, by which time display was as important a function as practical defence.

KNIGHTS IN COMBAT

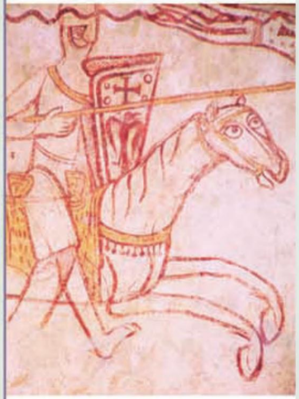
The evolution of armour also led to changes in weaponry. The ideal knightly combat – rarely encountered outside jousting tournaments – started with a charge with couched lance (held in the attacking position), followed by a close-quarters mêlée. In the era of mail, knights hacked

KEY **FORCE**

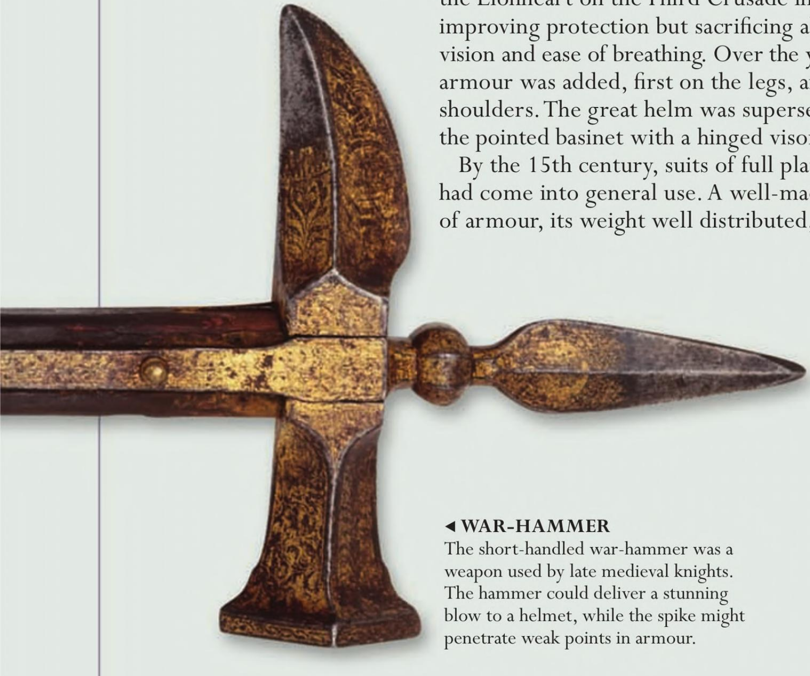
KNIGHTS TEMPLAR

1119–1312

Founded in Jerusalem during the Crusades, the Knights Templar were a military organization dedicated to the defence of Christianity. While following religious rules of conduct, the Templars were also elite fighters in the Crusader wars against Muslim forces. They took part in the failed defence of the last of the Crusader kingdoms in 1291, after which they were suppressed by the papacy and their wealth plundered by King Philip IV of France.

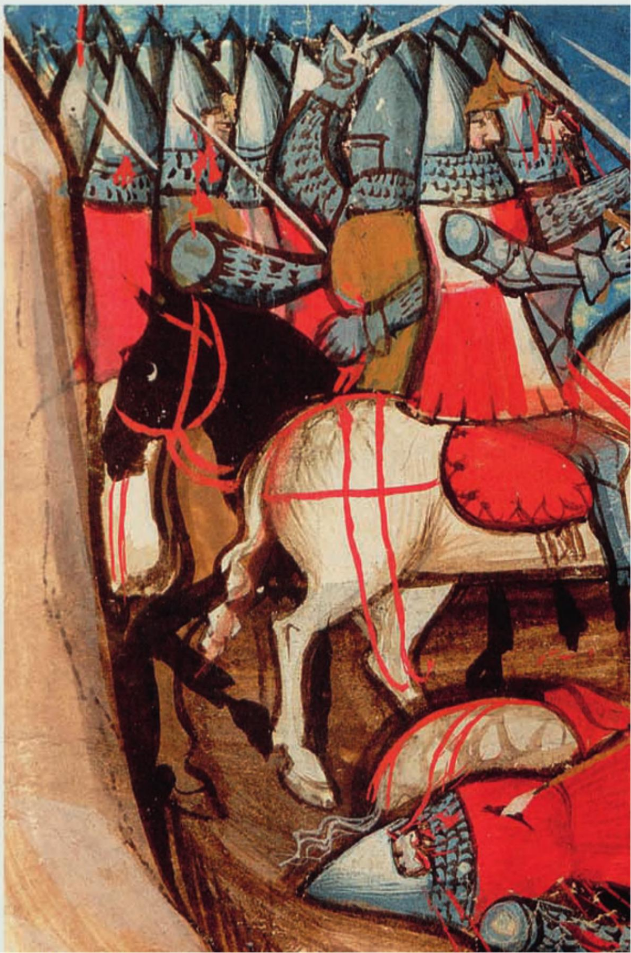


▲ A knight charges with his lance at the ready. The cross on his shield identifies him as a crusader.

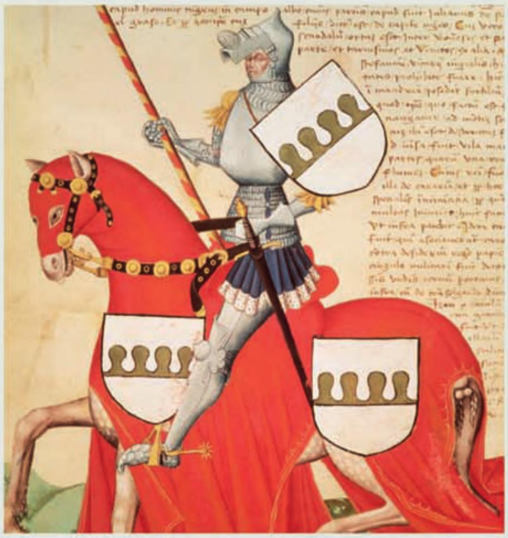


◂ WAR-HAMMER

The short-handled war-hammer was a weapon used by late medieval knights. The hammer could deliver a stunning blow to a helmet, while the spike might penetrate weak points in armour.



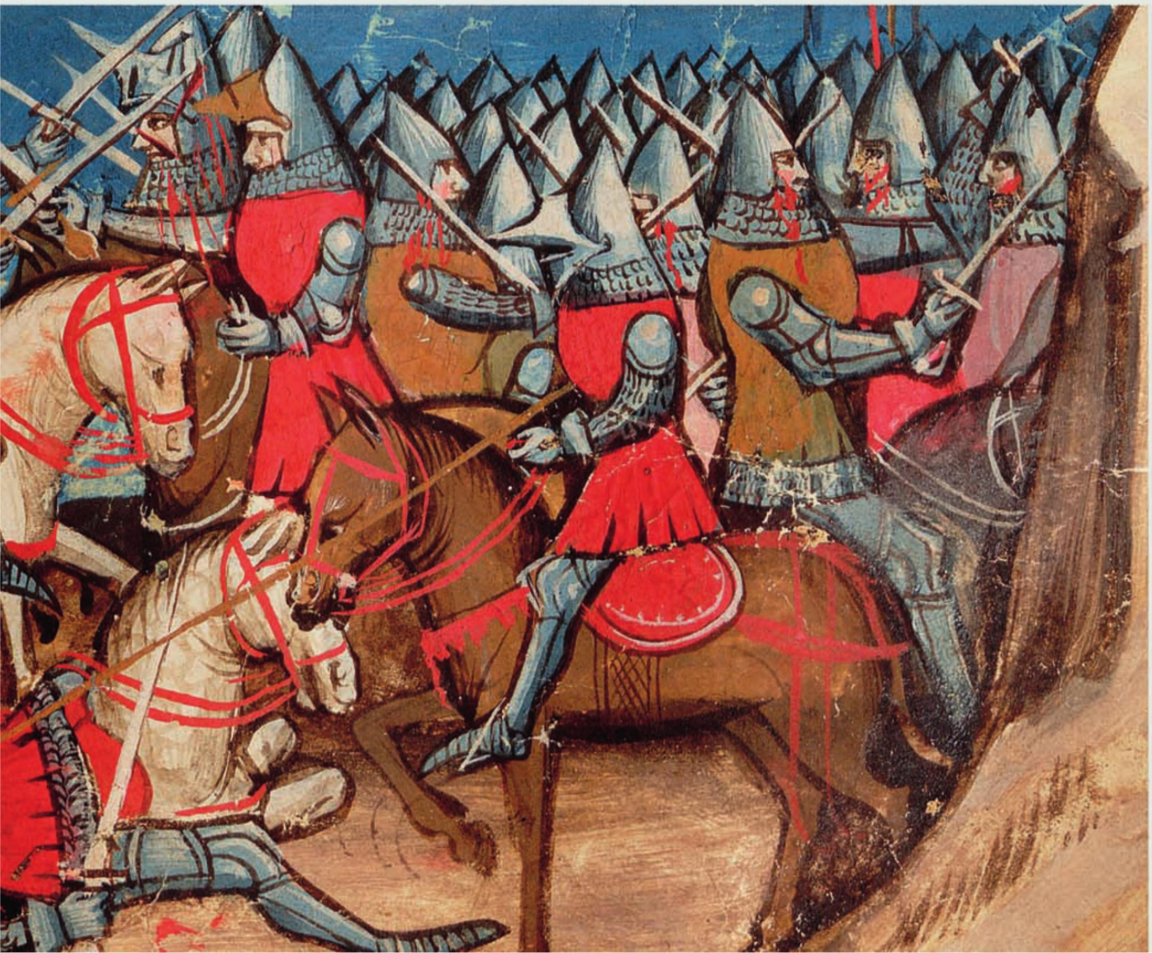
at one another with broad swords, while fending off blows with their shields. The adoption of full plate armour, which was itself as hard as a sword blade and curved to deflect blows, made shields redundant. The only way a sword could harm a knight was with a thrust of the point through one of the joints in the armour. More effective were the mace and the formidable war-hammer. A blow on the helmet with one of these percussive weapons could stun the knight inside, disabling him without need to penetrate his armour. To their humiliation, mounted knights often proved vulnerable to foot soldiers. They rarely succeeded in adequately protecting their horses, especially against arrows, and being unhorsed in the middle of a battle was often a fatal experience. In practice, especially in western Europe, knights increasingly dismounted for combat, fighting as armoured infantry.



◂ **HERALDIC SIGNS**
This 15th-century illumination shows a knight riding a horse, which is wearing a red caparison (cloth). The shields display a heraldic device: such devices were both a mark of status and a practical means of identification.

“When **battle is joined** let all **noble knights** think nothing of the **breaking of heads and arms**, for it is **better to die** than be vanquished and live”

BERTRAN DE BORN, FRENCH TROUBADOUR, c.1140–1215



◂ **A SWORD BATTLE**
This 14th-century illustration shows sword-armed knights wearing basinet helmets and mail, with plate armour covering their vulnerable arms, torso, and legs. Cloth surcoats helped keep their armour cooler in the sun.

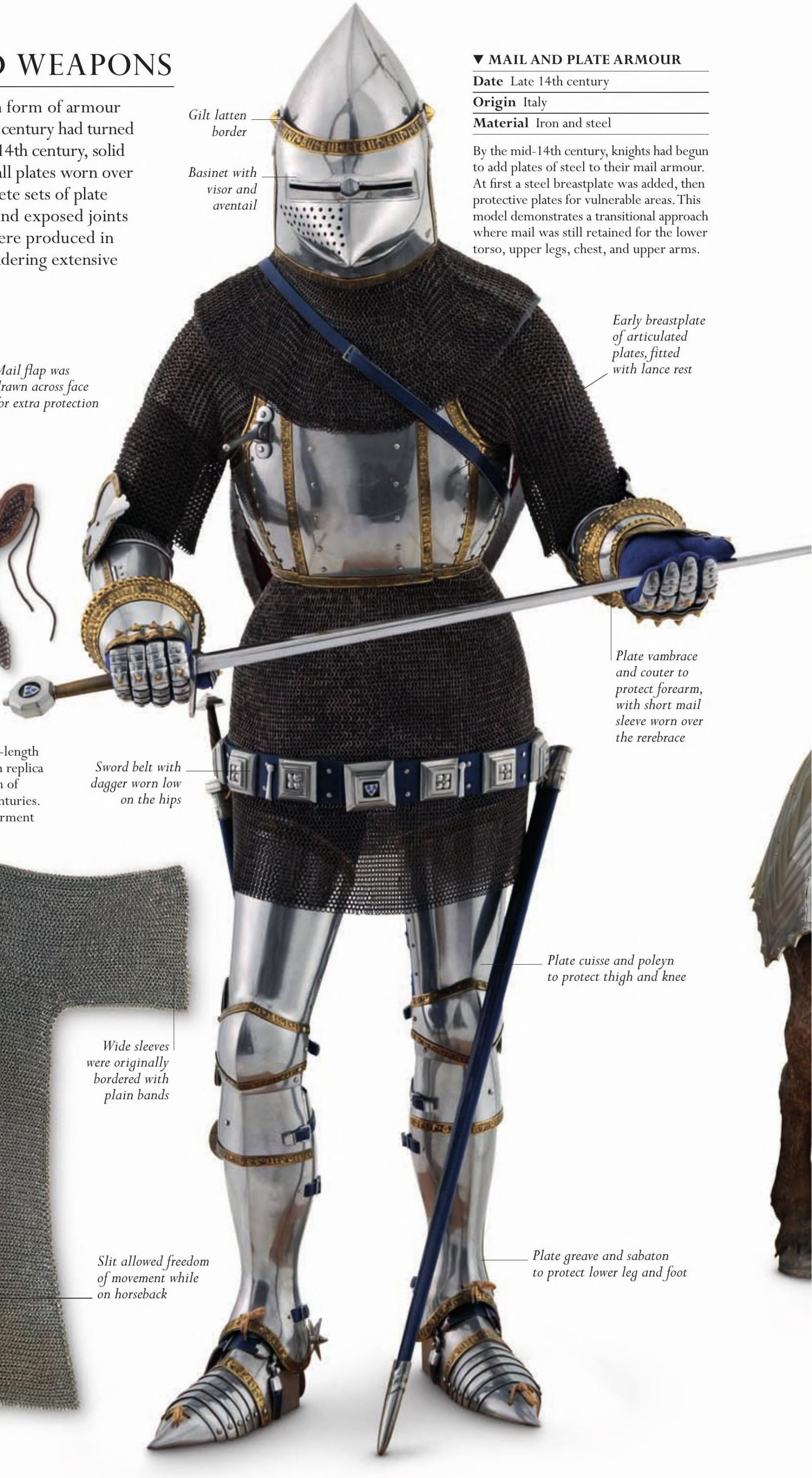
KEY **EVENTS**

1000–1500

- **1081** Norman horsemen use the charge with couched lance against Byzantine forces at the Battle of Dyrrhachium.
- **From 1096** European knights fight Crusades to secure Christian states in Palestine and Syria.
- **1000–1500** Spanish knights fight the wars of the Reconquista, wresting Iberia from Muslim rule.
- **1350** The visored basinet becomes standard for knights.
- **c.1350** Full plate armour comes into general use for European knights; meanwhile, war-hammers are introduced as a means of attacking it.
- **1337–1453** The kings of England and France fight a series of conflicts known as the Hundred Years’ War.

KNIGHTS' ARMOUR AND WEAPONS

During the early Middle Ages, the most common form of armour was a mail coat of riveted iron rings, which by the 13th century had turned into elaborate mail protection from head to toe. In the 14th century, solid metal was introduced into armour, beginning with small plates worn over vulnerable parts of the body, followed by more complete sets of plate during the 15th century: mail was retained only behind exposed joints in the armour. The most elaborate sets of armour were produced in the 16th century. By then, however, firearms were rendering extensive armour redundant.

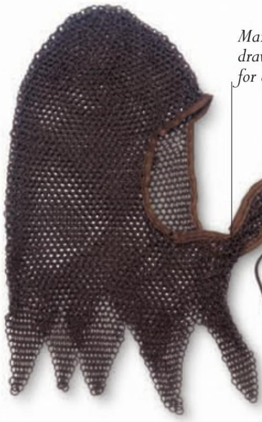


Gilt latten border
Basinet with visor and aventail
Early breastplate of articulated plates, fitted with lance rest
Plate vambrace and couter to protect forearm, with short mail sleeve worn over the rerebrace
Sword belt with dagger worn low on the hips
Plate cuisse and poleyn to protect thigh and knee
Plate greave and sabaton to protect lower leg and foot

▼ MAIL AND PLATE ARMOUR

Date Late 14th century
Origin Italy
Material Iron and steel

By the mid-14th century, knights had begun to add plates of steel to their mail armour. At first a steel breastplate was added, then protective plates for vulnerable areas. This model demonstrates a transitional approach where mail was still retained for the lower torso, upper legs, chest, and upper arms.



Mail flap was drawn across face for extra protection

▶ MAIL COIF

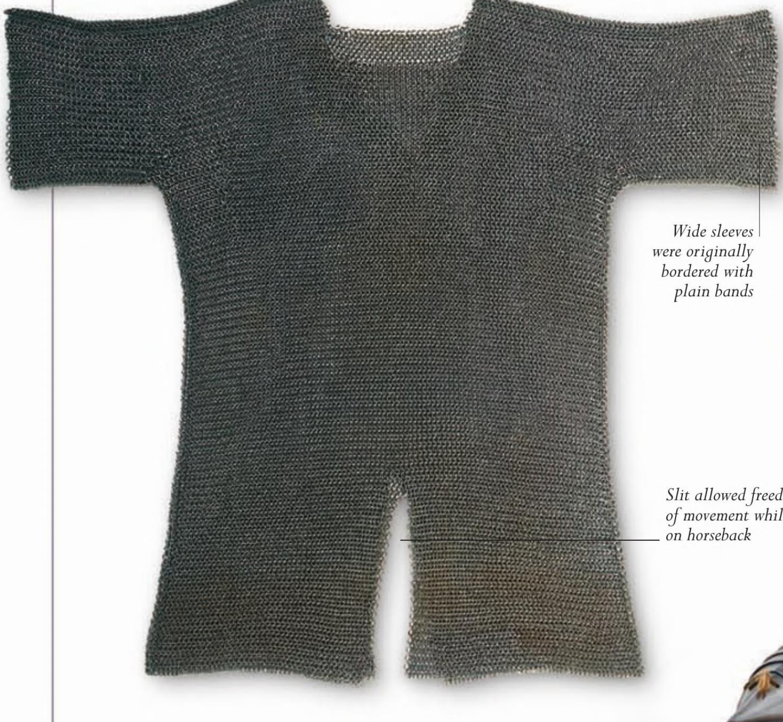
Date Medieval
Origin Europe
Material Iron

A mail coif – a close-fitting hood – was worn under the helm, leaving only the nose and eyes unprotected. Originally it was attached to the mail coat or hauberk, but was later separated. The example shown is a replica.

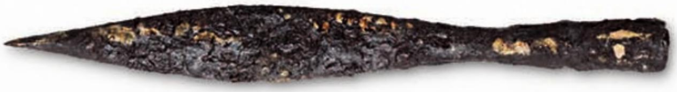
▼ MAIL HAUBERK

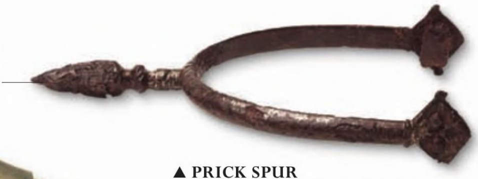
Date 11th–12th century
Origin Northern Europe
Material Iron

The hauberk or byrnie – a knee-length shirt of mail such as the modern replica shown here – was the main item of armour in the 11th and 12th centuries. Knights wore a padded undergarment called an aketon underneath it.



Wide sleeves were originally bordered with plain bands
Slit allowed freedom of movement while on horseback





Spike protruded from spur, worn on the heel by the knight

▲ LANCE HEAD

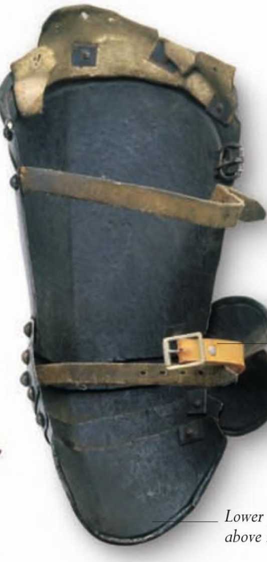
Date 12th–13th century
Origin Europe
Weight 90g (3oz)
Length 19.4cm (7½in)

Long lances were used as shock weapons after a charge in combat or in a tournament. Metal combat lance heads, such as this one, could pierce gaps in plate armour, leaving terrible wounds.

▶ CUISSE AND POLEYN

Date 16th century
Origin Europe
Material Steel

The cuisse was a plate that protected the lower thigh, fastened in place with buckles. It first became common in the 14th century and was sometimes made of two separate plates, which allowed for greater flexibility. The poleyn protected the knee.



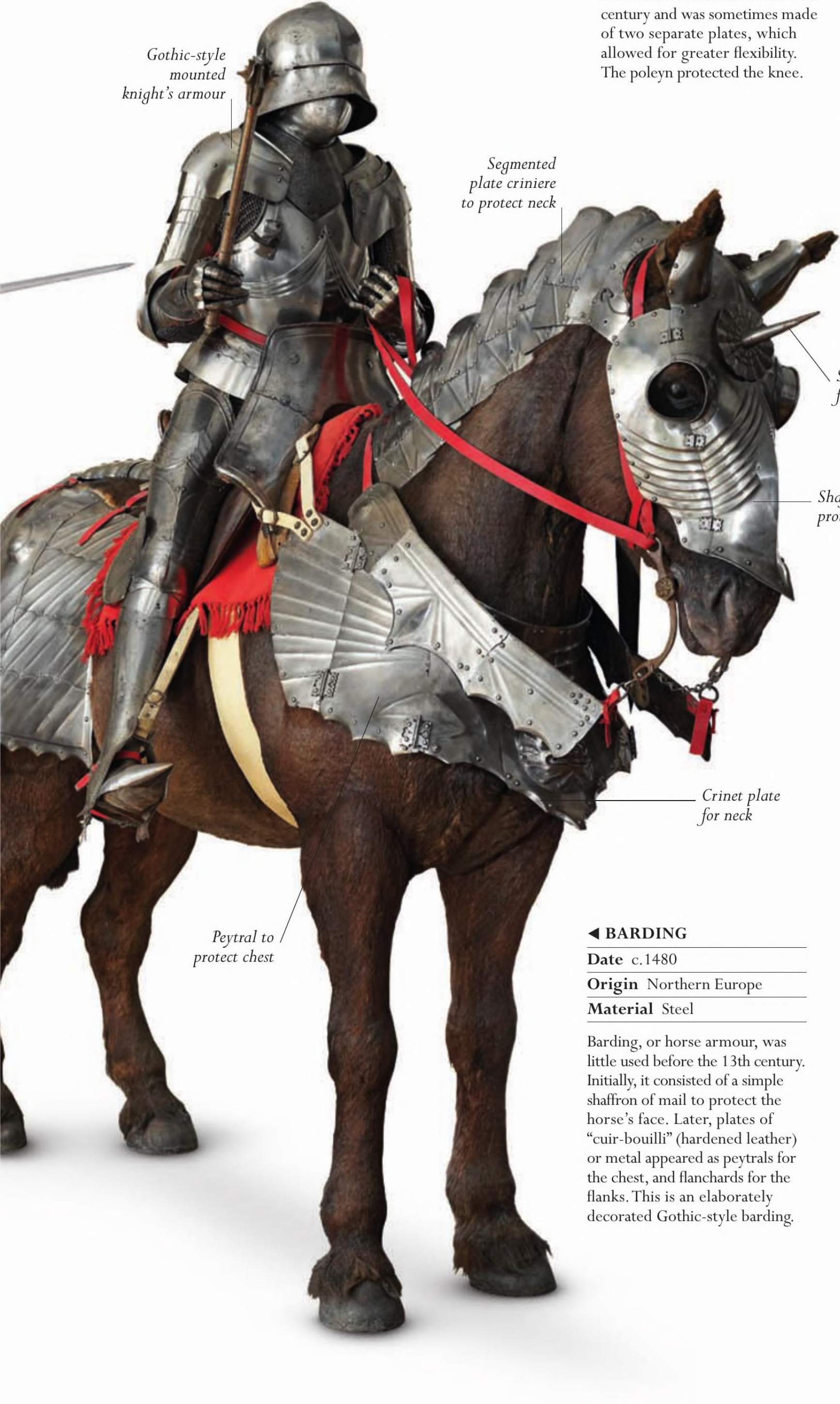
Straps for attaching to leg

Lower part attaches above knee joint

▲ PRICK SPUR

Date 11th century
Origin Europe
Material Iron

The prick spur had a single iron spike to guide the horse by prodding its flank. It was the most common form of spur until the introduction of the rowel spur in the late 13th century, which featured multiple points.



Gothic-style mounted knight's armour

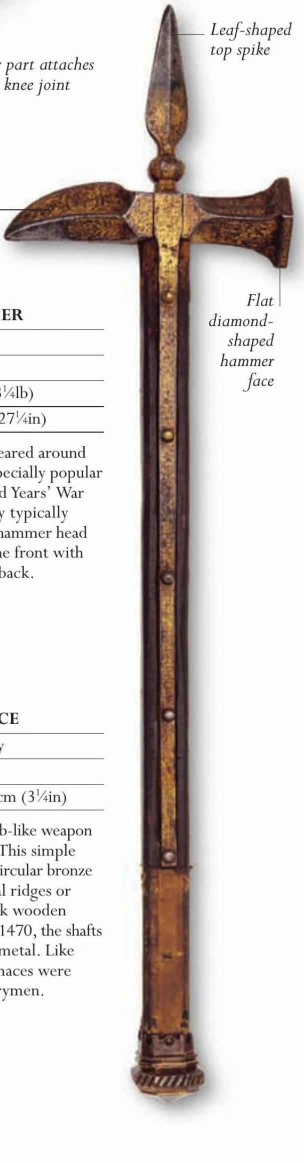
Segmented plate criniere to protect neck

Spike protruding from roundel

Shaffron to protect face

Crinet plate for neck

Peytral to protect chest



Leaf-shaped top spike

Diamond-section protruding pick at the back

Flat diamond-shaped hammer face

▶ WAR-HAMMER

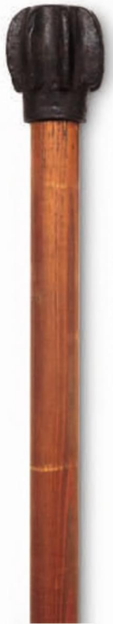
Date c.1490
Origin Europe
Weight 1.51kg (3¼lb)
Length 69.5cm (27¼in)

War-hammers appeared around 1250, and were especially popular during the Hundred Years' War (1337–1453). They typically comprised a blunt hammer head or set of claws at the front with a sharp pick at the back.

◀ BARDING

Date c.1480
Origin Northern Europe
Material Steel

Barding, or horse armour, was little used before the 13th century. Initially, it consisted of a simple shaffron of mail to protect the horse's face. Later, plates of "cuir-bouilli" (hardened leather) or metal appeared as peytrals for the chest, and flanchards for the flanks. This is an elaborately decorated Gothic-style barding.



◀ BRONZE MACE

Date 14th century
Origin Europe
Length (Head) 8cm (3¼in)

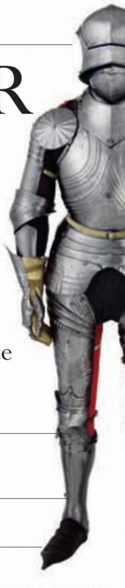
The mace was a club-like weapon with a metal head. This simple mace consists of a circular bronze head – with vertical ridges or flanges – and a thick wooden shaft. After around 1470, the shafts were also made of metal. Like the war-hammer, maces were popular with cavalrymen.

FULL STEEL PLATE PROTECTION

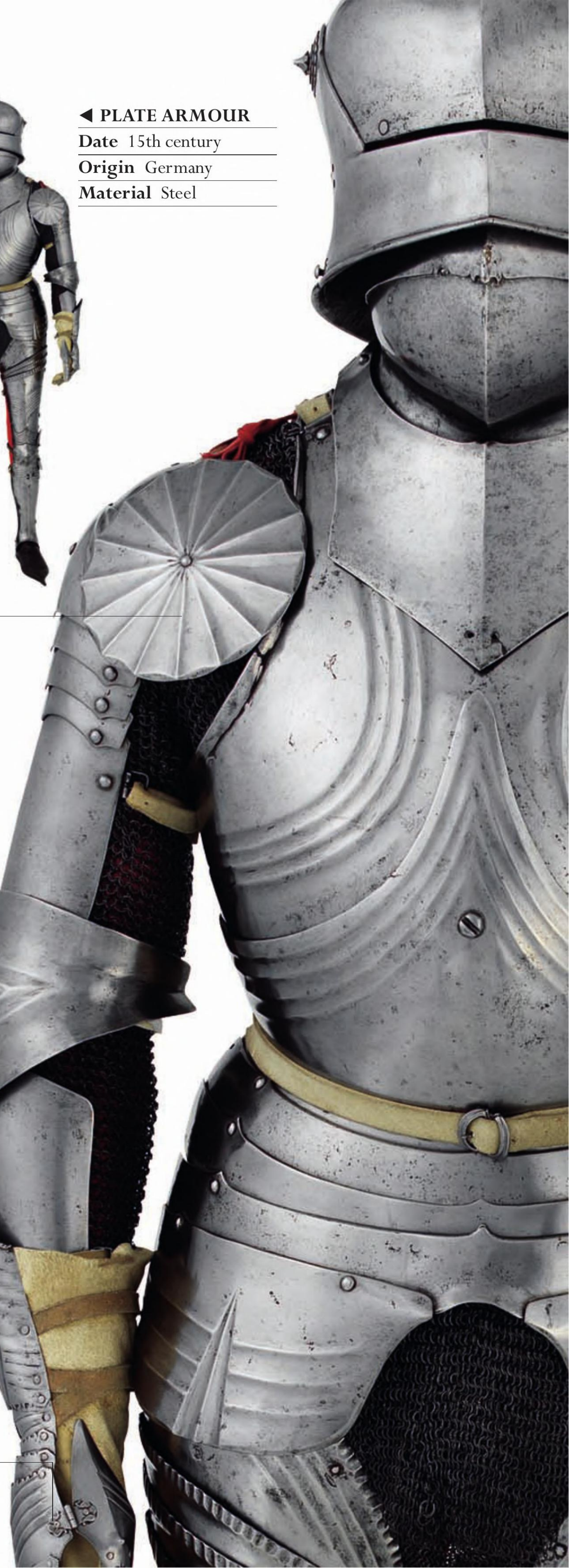
MEDIEVAL ARMOUR

The full steel plate armour worn by knights in the late 15th century offered excellent protection. The helmet was curved in order to deflect the impact of blows from blunt weapons, such as maces, while slashing strokes from swords glanced off almost any part of the surface. The armour was so effective that it offered its wearer protection from everything but crossbow bolts. This Gothic-style armour, with its elaborate decorative details, was made in Germany.

► ARMOUR
Full plate armour was designed to offer a good degree of mobility to its wearer – certainly enough to participate in close-quarters combat on foot or horseback. At around 18kg (40lbs), it was also surpisingly light, and offered such good protection against blows from swords and other edged weapons that the use of more effective blunt weapons such as war-hammers grew increasingly widespread.

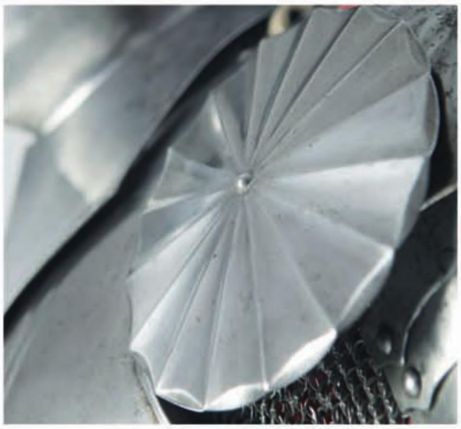


FULL VIEW

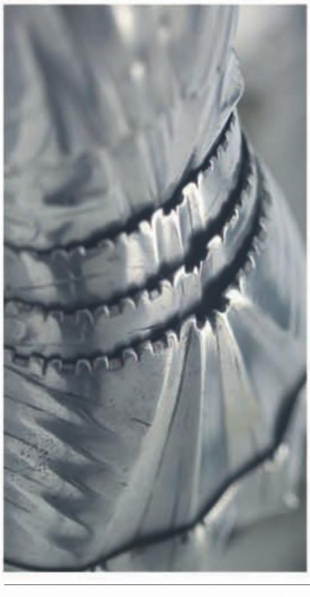


◄ PLATE ARMOUR

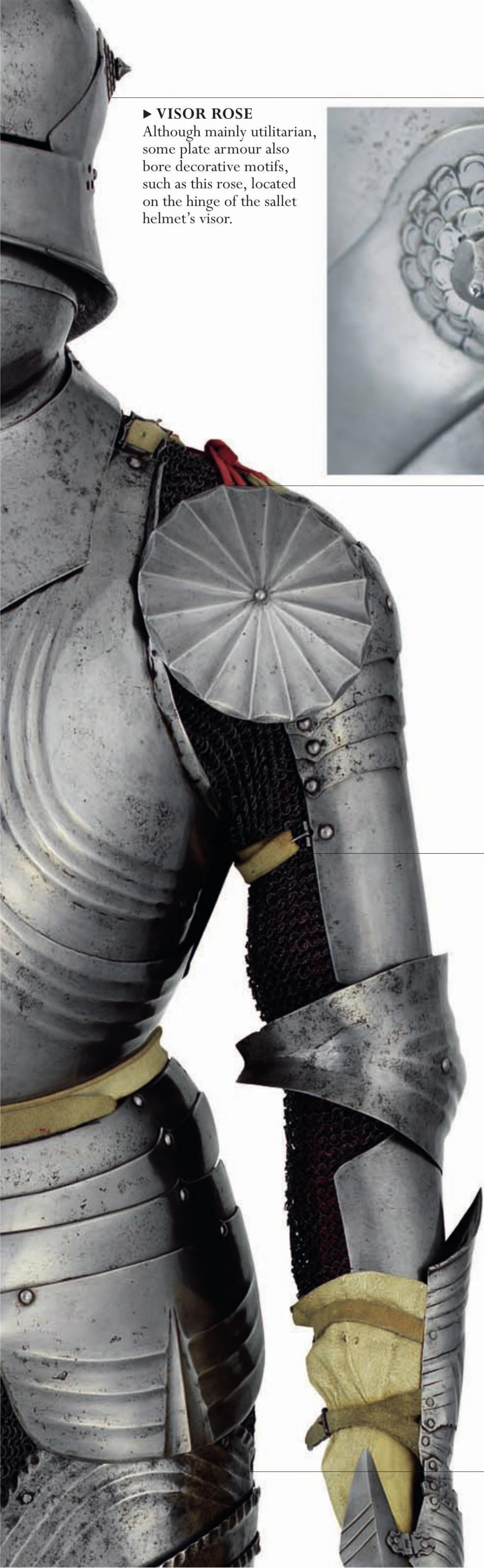
Date	15th century
Origin	Germany
Material	Steel



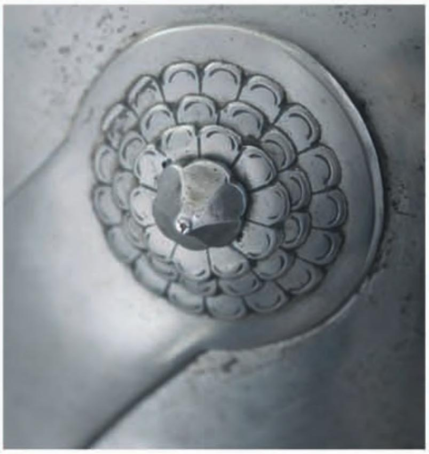
◄ BESAGEW
These small, round shields were attached to the buckle on the shoulder to defend the armpit. Although uncommon in the 14th century, they reappeared in later armour.

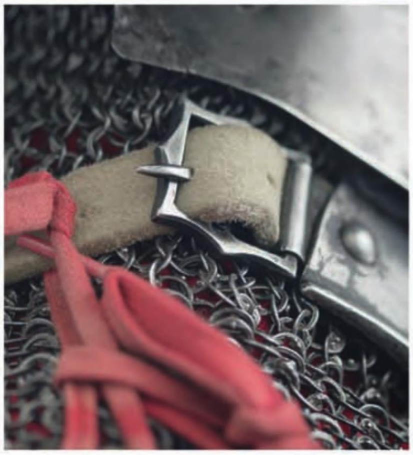


◄▲ GAUNTLET
This hand-protecting armour had a series of intricately articulated plates to allow movement.

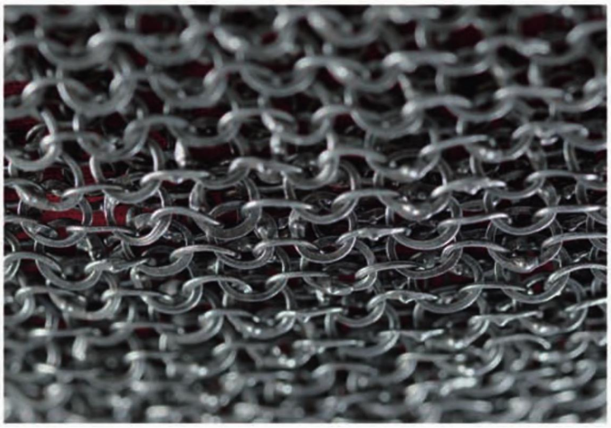


▸ VISOR ROSE
Although mainly utilitarian, some plate armour also bore decorative motifs, such as this rose, located on the hinge of the sallet helmet's visor.



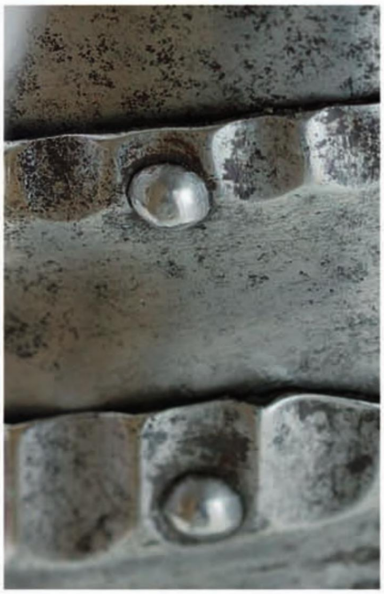


◂ BUCKLE
This buckle on the breastplate secured it to the back plate.



◂ MAIL
This protected exposed areas, such as the inner arms. Occasionally full mail hauberks were worn beneath the plate armour.

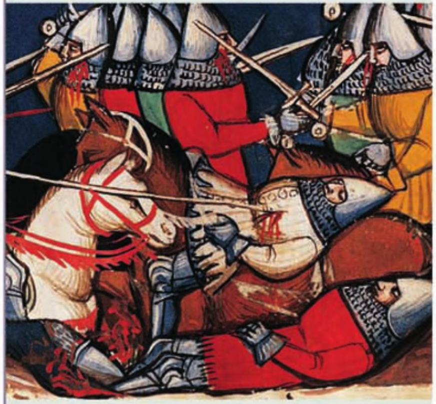
▾ CUISSE
Named after the French word for "thigh", this armour for the upper leg was designed to protect against blows both from forward-facing opponents, and upward strikes that might be dealt to the wearer when he was on horseback.



IN ACTION

ARMOUR IN BATTLE

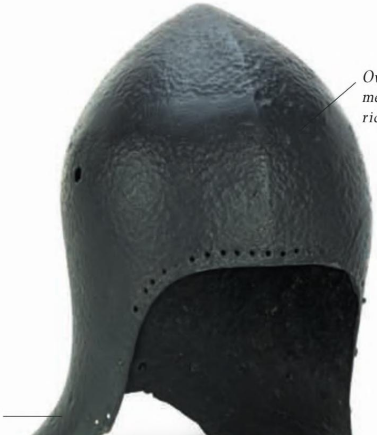
Knights sometimes wore a combination of mail and plate armour, along with with a visored basinet, an aventail (mail collar), and a mail hauberk under a pair of plates covered with fabric. Despite the relatively high level of protection that plate armour offered its wearer, casualties were a regular occurrence, and mounted knights were particularly at risk from footsoldiers armed with staff weapons.



▲ The protection of full plate armour could count for little if a knight was unhorsed.

KNIGHTS' HELMETS

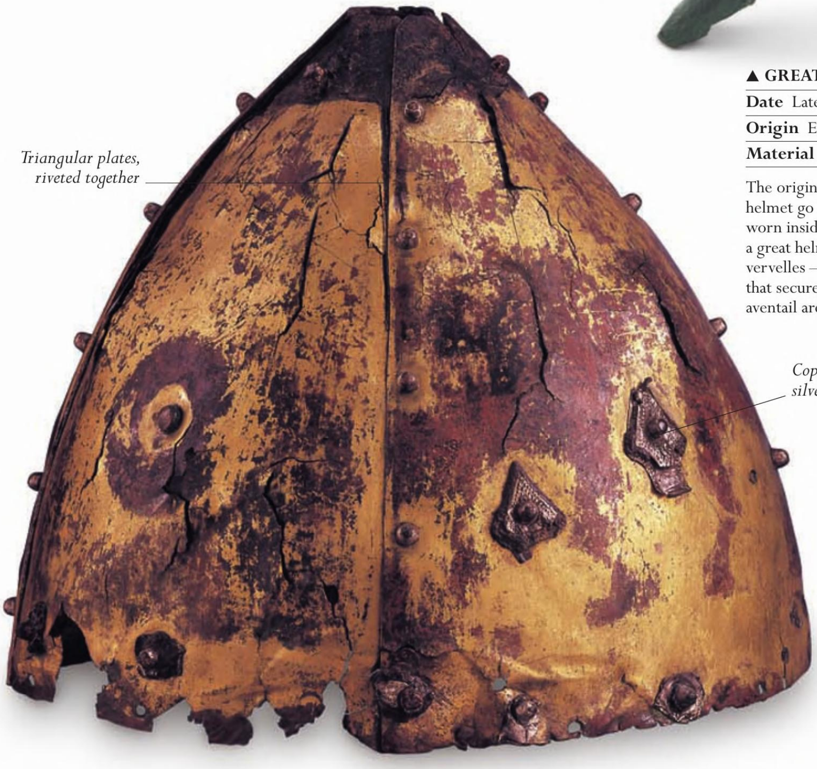
The helmets worn by the Normans in the 11th and 12th centuries were little different from the *Spangenhelms* of the Dark Ages – high, conical metal caps with nose guards. From the 12th century, however, rounder helmets evolved, which eventually covered the whole face. These great helms proved cumbersome and, in the 14th century, were superseded by basinets, which allowed the wearer extra mobility and visibility at the cost of some protection. Helmets appeared in ever greater varieties in the 15th century, including barbutes and the lighter sallets, as well as armets, which had hinged cheekpieces that fastened under the chin.


Ovoid, medially ridged form
Flared sides

▲ GREAT BASINET

Date Late 14th century
Origin England
Material Steel

The origins of the great basinet helmet go back to the metal skullcap worn inside a mail coif and under a great helm. The holes for the vervelles – rivet-like metal staples – that secured this basinet to the mail aventail are visible.

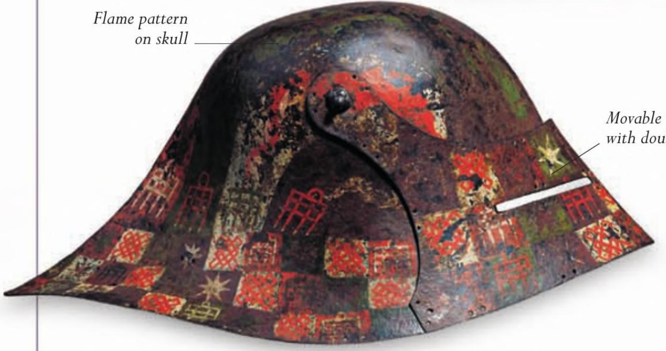

Triangular plates, riveted together
Copper rivets with silver-bound heads

◀ SEGMENTED HELM

Date 11th century
Origin Poland
Material Iron, copper

Segmented helms are typical of early medieval designs. This helm was constructed from four triangular iron plates, originally covered in gilt copper sheet, and joined by copper rivets.

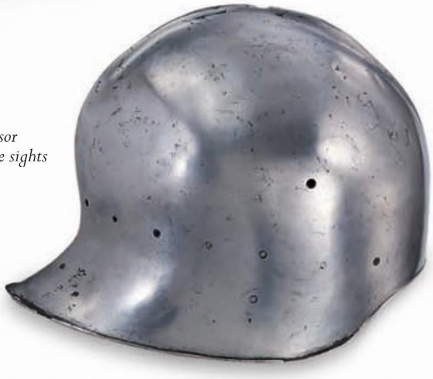
Mail aventail


Flame pattern on skull
Movable visor with double sights

▲ PAINTED SALLET

Date 1490
Origin Northern Europe
Material Steel

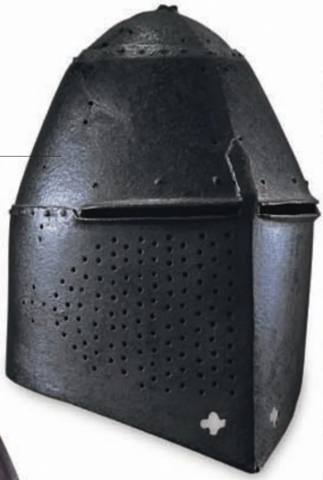
Sallets were light helmets that developed from the basinet. They usually had a long tail to protect the neck. This one has a painted design, while others were covered with cloth.



▲ SHORT-TAILED SALLET

Date c.1440
Origin Northern Italy
Material Steel

Originally from Italy, sallets were worn by both knights and foot soldiers. This one has a much shorter tail than many other types, and does not have a visor.


Rounded skull

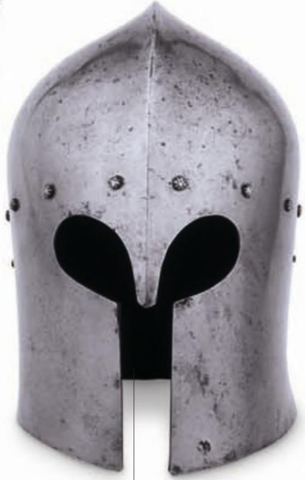
◀ GREAT HELM

Date c.1350

Origin England

Material Steel

The great helm covered the whole face and head and became common in the 12th century. It was made with three plates of steel, with a pointed crown and rounded skull to deflect blows, and had only narrow slots for vision.


Y-shaped opening for face

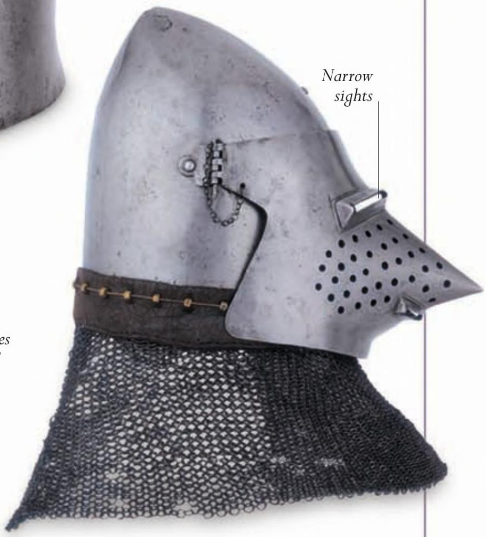
◀ BARBUTE

Date c.1445

Origin Italy

Material Steel

The barbute had a pointed top and rounded cheekpieces, but no visor, which left a small opening for the face. This example is known as a "Corinthian barbute" for its similarity to classical Greek helmets.


Narrow sights

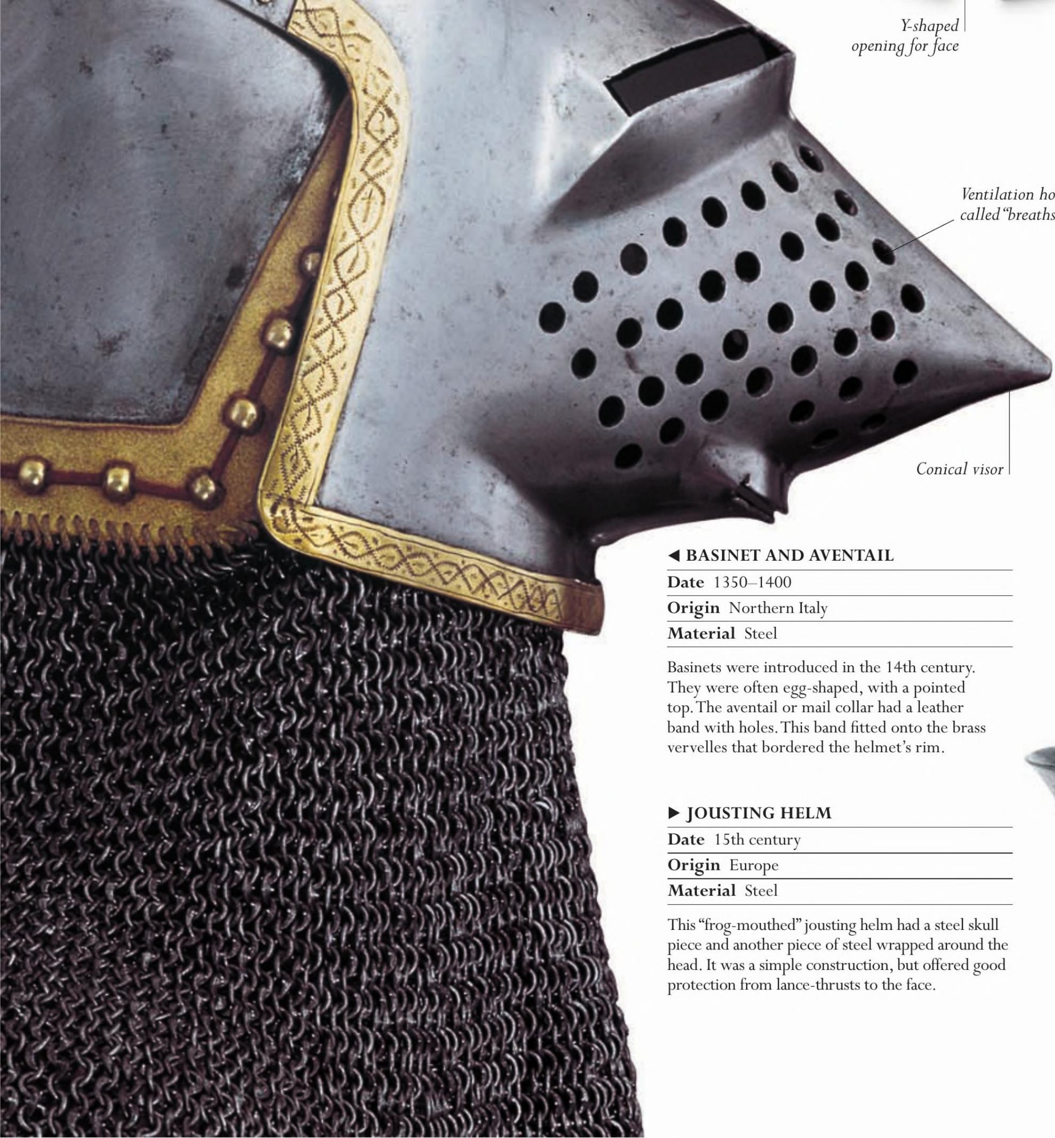
▲ HOUNSKULL BASINET

Date 1350–1400

Origin Italy

Material Steel

This hounskull basinet – its name a corruption of the German *Hundsgugel* ("dog head"), from its pointed visor – has the typical aventail or mail collar to protect the wearer's neck and shoulders.


Brass borders decorated with "wriggled" cable pattern
Ventilation holes called "breaths"
Conical visor

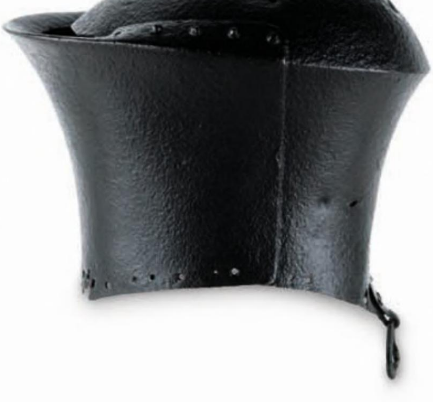
◀ BASINET AND AVENTAIL

Date 1350–1400

Origin Northern Italy

Material Steel

Basinets were introduced in the 14th century. They were often egg-shaped, with a pointed top. The aventail or mail collar had a leather band with holes. This band fitted onto the brass vervelles that bordered the helmet's rim.



▶ JOUSTING HELM

Date 15th century

Origin Europe

Material Steel

This "frog-mouthed" jousting helm had a steel skull piece and another piece of steel wrapped around the head. It was a simple construction, but offered good protection from lance-thrusts to the face.

A CLASH OF KNIGHTS

THE BATTLE OF BOUVINES

Though medieval rulers often launched military campaigns, they were wary of pitched battles. The meeting of European armies at Bouvines in 1214 was a rare clash between large bodies of knights, a set-piece battle that epitomized the fighting style of the era's armoured horsemen.

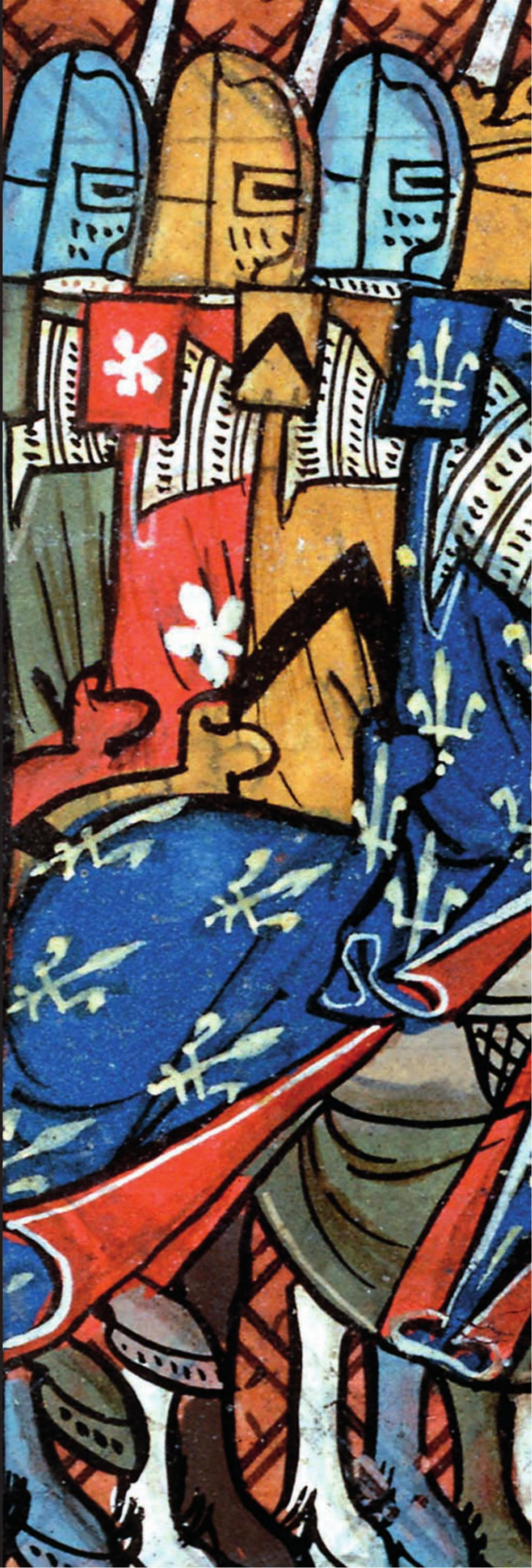
In the summer of 1214, King Philip II of France faced an army led by the Holy Roman Emperor Otto IV and Ferdinand, Count of Flanders. The two armies encountered one another near Bouvines in Flanders on 27 July, and engaged in battle. The French king was accompanied by his feudal lords and their armed followers, and by citizen militia from the towns. The Imperial army – Germans, Flemings, and English – was similarly structured, ranging from noblemen to the armed artisans of the Flemish towns. Both sides also employed mercenaries, fighting for pay or plunder.

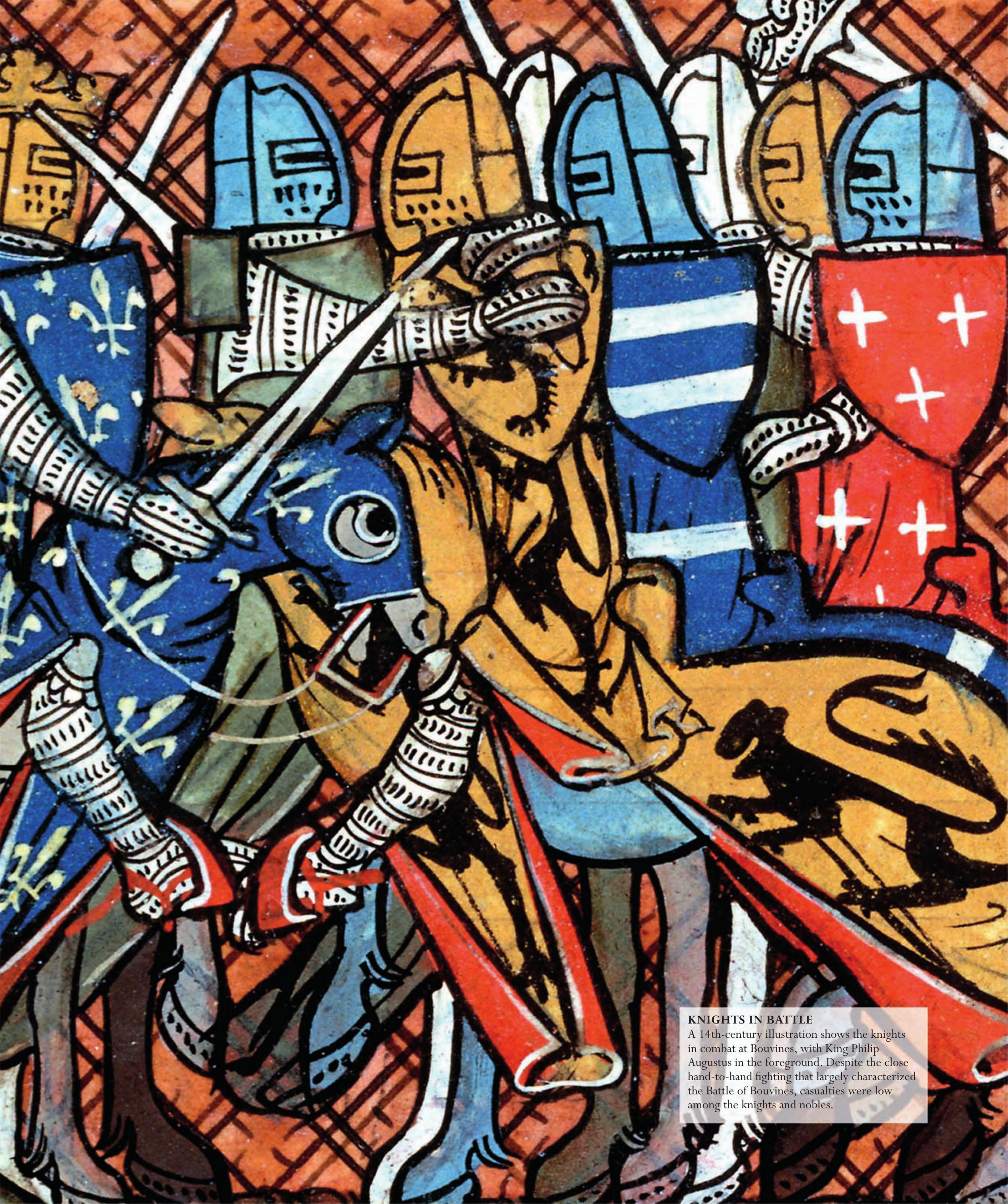
It was symmetrical warfare, the two sides fighting with the same weapons (mainly edged or percussion mêlée weapons), tactics, and military codes. Both armies were drawn up with armoured horsemen – nobles, knights, and unknighted sergeants – on the flanks, and foot soldiers in the centre. The king and the emperor each placed himself behind the infantry in the midst of his household knights, who formed a cavalry reserve. The field was dotted with banners – a practical visual identification for the different feudal contingents. The Imperial army was larger, with around 25,000 men against 15,000 French, but the numbers of mounted men on each side were similar, probably about 4,000. Philip's army spread out thinly, matching the length of the enemy line to avoid being outflanked.

CLOSE COMBAT

The battle began without clear plan or central command. Amid a cacophony of trumpets, shouted insults, and prayers, some of the armies' troops attacked, while others hesitated or stood on the defensive. Bodies of knights lowered their lances and charged the facing cavalry, their lances shattering on impact, while some nobles sought out particular enemies against whom they held a grudge. Although knights would not shy away from clashes with infantry, they preferred to engage their peers; it was sometimes seen as degrading to fight against opponents of lower social status. However, soon such distinctions were lost as a vast mêlée broke out across the battlefield. Knights hacked at one another with swords, daggers, axes, and maces. Their mail armour and plate helmets were resistant to most blows, but horses were more vulnerable: many savagely wounded mounts fell, bringing their riders to the ground. Foot soldiers also proved adept at unhorsing knights, snagging their armour with hooks and spears. Philip himself was unhorsed by Flemish infantry, and was lucky to escape with his life.

Eventually the French gained the upper hand, their horsemen emerging victorious. In the centre, the emperor was overrun and his banner captured, although Otto himself escaped the field. The last of the Imperial forces to hold out was Renaud of Boulogne, a doughty fighter who organized 700 pikemen in a circle, keeping the French knights at bay using the reach of their weapons. When they fell, the battle ended. Three counts, 25 barons, and about 100 knights were led off as privileged prisoners: it was not considered dishonourable to surrender and, because of the financial value of ransom, surrender was usually accepted. Thus, few nobles or knights fought to the death.

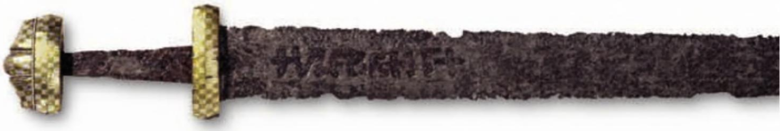




KNIGHTS IN BATTLE
A 14th-century illustration shows the knights in combat at Bouvines, with King Philip Augustus in the foreground. Despite the close hand-to-hand fighting that largely characterized the Battle of Bouvines, casualties were low among the knights and nobles.

EUROPEAN SWORDS

The sword was the medieval European warrior's most valued weapon. Magnificent blades were often handed down through the generations. Swords were also a symbol of the status and prestige of a knight – a man was made a knight by being dubbed on the shoulders with a sword. Early medieval swords were designed as hacking and slashing weapons to break the mail armour prevalent up to the mid-13th century. But between 1275 and 1350, a transition occurred, with the development of sharply pointed thrusting swords with longer blades better adapted to dealing with plate armour.



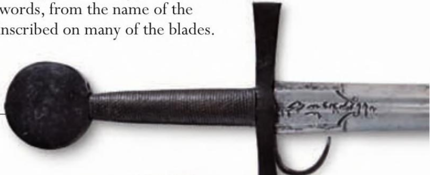
▲ GERMAN ULFBERHT SWORD

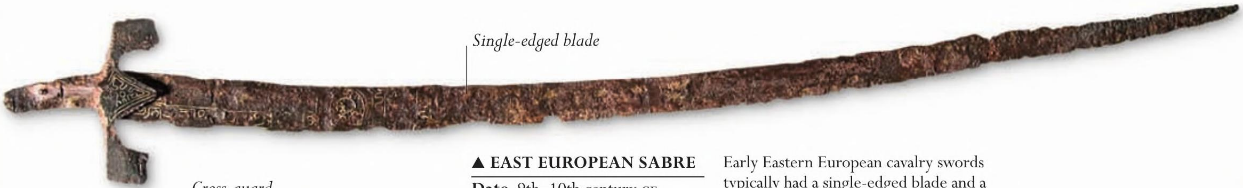
Date c.900CE

Origin Northern Europe

Length 76cm (30in)

Around 900CE, a new type of sword emerged, as long as its Celtic predecessors but tapering more sharply, with a balance point closer to the hilt. Some weapons of this type are known as Ulfberht swords, from the name of the swordsmith inscribed on many of the blades.


Rounded pommel
Finger ring below guard


Single-edged blade

▲ EAST EUROPEAN SABRE

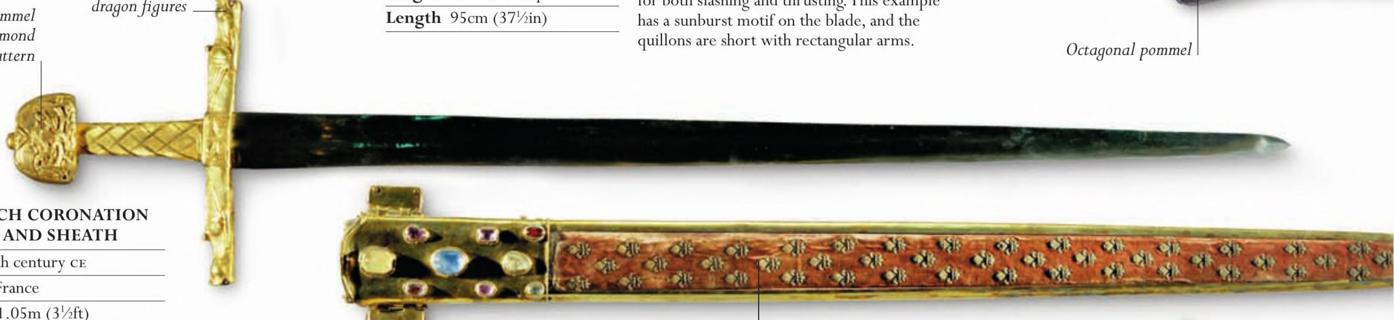
Date 9th–10th century CE

Origin Eastern Europe

Length 95cm (37½in)

Early Eastern European cavalry swords typically had a single-edged blade and a double-edged point, making them suitable for both slashing and thrusting. This example has a sunburst motif on the blade, and the quillons are short with rectangular arms.

Octagonal pommel


Gold pommel with diamond net pattern
Cross-guard with winged dragon figures
Gemstone mounted on filigree bezel
Sheath with fleur-de-lys pattern

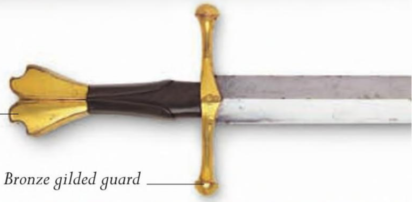
▶ FRENCH CORONATION SWORD AND SHEATH

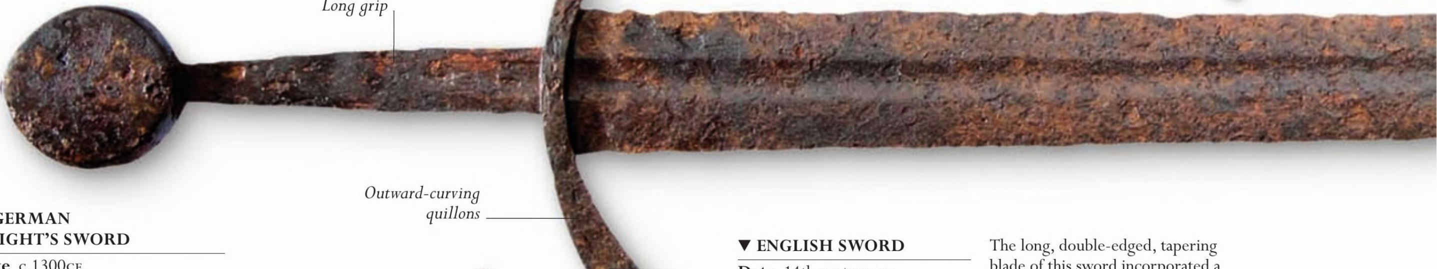
Date 12th century CE

Origin France

Length 1.05m (3½ft)

This composite sword is traditionally said to have been "Joyeuse", the sword of Charlemagne, although it was first recorded as the coronation sword of Philip the Bold in 1271.


Fish-tail pommel
Bronze gilded guard


Long grip
Outward-curving quillons

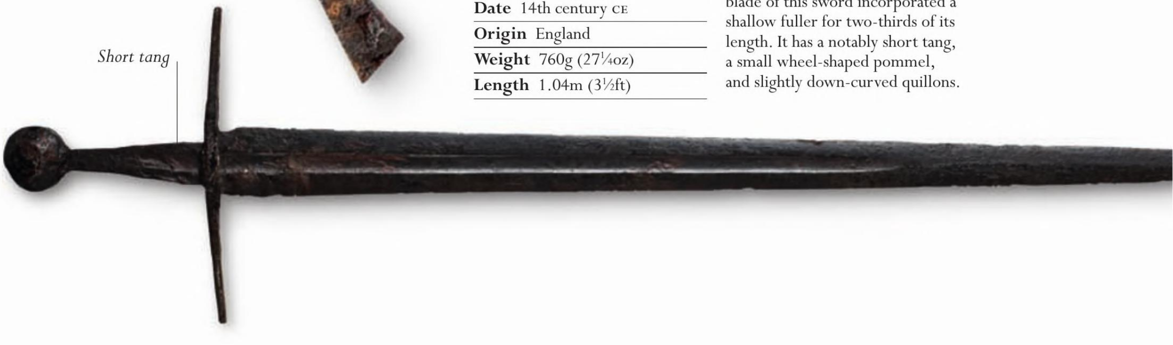
▲ GERMAN KNIGHT'S SWORD

Date c.1300CE

Origin Northern Europe

Length 1.09m (3½ft)

Belonging to one of the last generations of blade before the tips of swords became more pointed, this broad-bladed sword has a forward-curving cross-guard and flat, disc-shaped pommel. It came from Passau (in modern-day Germany), a town noted for its sword-makers.



▼ ENGLISH SWORD

Date 14th century CE

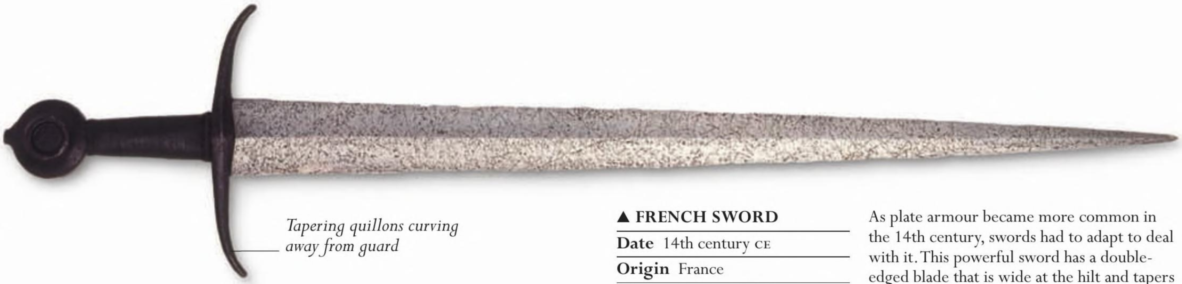
Origin England

Weight 760g (27¼oz)

Length 1.04m (3½ft)

The long, double-edged, tapering blade of this sword incorporated a shallow fuller for two-thirds of its length. It has a notably short tang, a small wheel-shaped pommel, and slightly down-curved quillons.

Broken blade



Tapering quillons curving away from guard

▲ FRENCH SWORD

Date	14th century CE
Origin	France
Weight	1.16kg (2½lb)
Length	85.7cm (33¼in)

As plate armour became more common in the 14th century, swords had to adapt to deal with it. This powerful sword has a double-edged blade that is wide at the hilt and tapers rapidly to a sharp point that could penetrate gaps in an opponent's armour.

Sharply tapered point

▲ ITALIAN SWORD

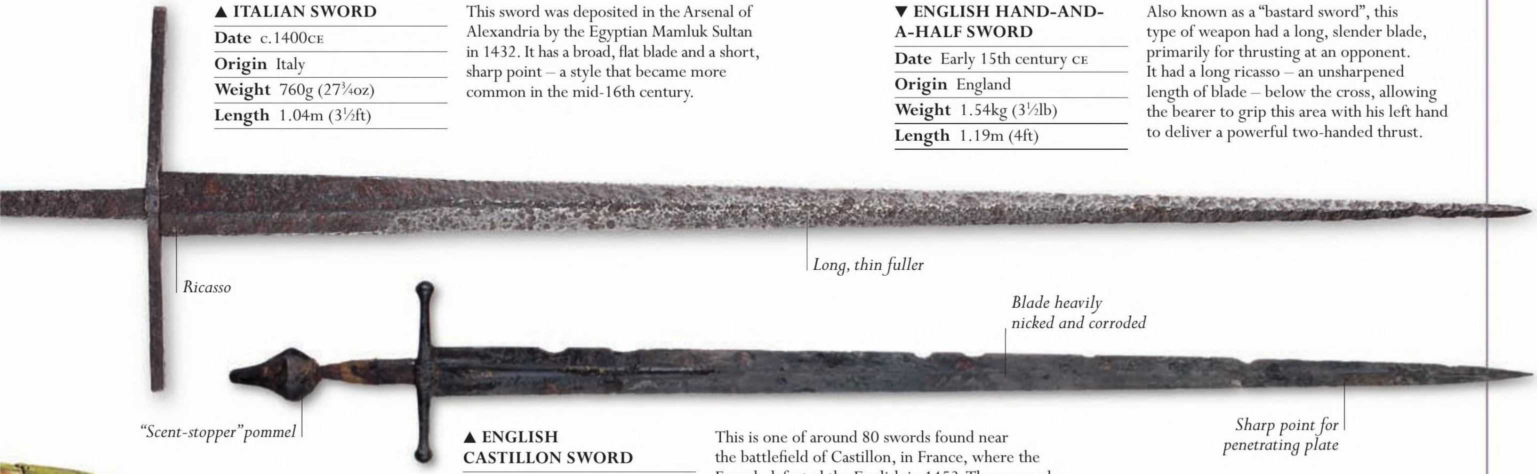
Date	c.1400CE
Origin	Italy
Weight	760g (27¾oz)
Length	1.04m (3½ft)

This sword was deposited in the Arsenal of Alexandria by the Egyptian Mamluk Sultan in 1432. It has a broad, flat blade and a short, sharp point – a style that became more common in the mid-16th century.

▼ ENGLISH HAND-AND-A-HALF SWORD

Date	Early 15th century CE
Origin	England
Weight	1.54kg (3½lb)
Length	1.19m (4ft)

Also known as a "bastard sword", this type of weapon had a long, slender blade, primarily for thrusting at an opponent. It had a long ricasso – an unsharpened length of blade – below the cross, allowing the bearer to grip this area with his left hand to deliver a powerful two-handed thrust.



Long, thin fuller
Ricasso
Blade heavily nicked and corroded
"Scent-stopper" pommel
Sharp point for penetrating plate

▲ ENGLISH CASTILLON SWORD

Date	Mid-15th century CE
Origin	England
Weight	1kg (2¼lb)
Length	1.09m (3½ft)

This is one of around 80 swords found near the battlefield of Castillon, in France, where the French defeated the English in 1453. These swords mostly had sharply tapering points. Although the blade of this sword is heavily corroded, traces of the original wooden grip and gilding survive.

◀ FLEMISH SWORD

Date	1460CE
Origin	Southern Europe
Weight	1.34kg (3lb)
Length	88.3cm (34¾in)

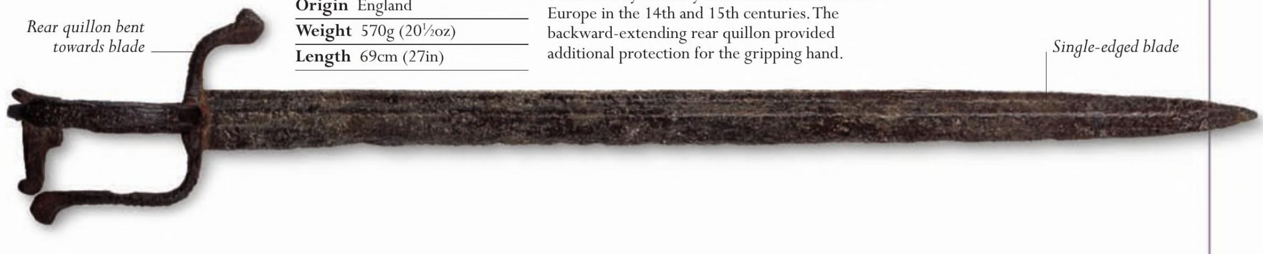
Both the hilt and the pommel of this extremely ornate sword were gilded. The grip carved from black horn was made to flow into the fish-shaped pommel. The double-edged blade has four sides that taper to a very sharp point.

Broad blade with central fuller
Curved tip

▼ ENGLISH SHORT SWORD

Date	1480–1520CE
Origin	England
Weight	570g (20½oz)
Length	69cm (27in)

Single-edged short swords were ideal for use against lightly armoured opponents and were often used by ordinary soldiers across northwest Europe in the 14th and 15th centuries. The backward-extending rear quillon provided additional protection for the gripping hand.



Rear quillon bent towards blade
Single-edged blade

KEY **EVENTS**

11TH–15TH CENTURY

- **11th century** The crossbow is used in European warfare, notably by the Genoese.
- **1139** Pope Innocent II bans the crossbow (along with other bows) because of the number of Christian knights it kills. The ban is ineffectual.
- **1176** The Battle of Legnano demonstrates the effectiveness of spear-armed infantry in tight formation, as Milanese foot soldiers defeat Emperor Frederick Barbarossa's knights.
- **1333** Flemish infantry defeat French knights at Courtrai.
- **1333** At Halidon Hill, King Edward III of England first deploys massed longbowmen, flanking dismounted knights.
- **1476** Swiss Confederacy foot soldiers defeat Charles the Bold at Murten, attacking in columns with long pikes and halberds.

KEY DEVELOPMENT

MEDIEVAL INFANTRY

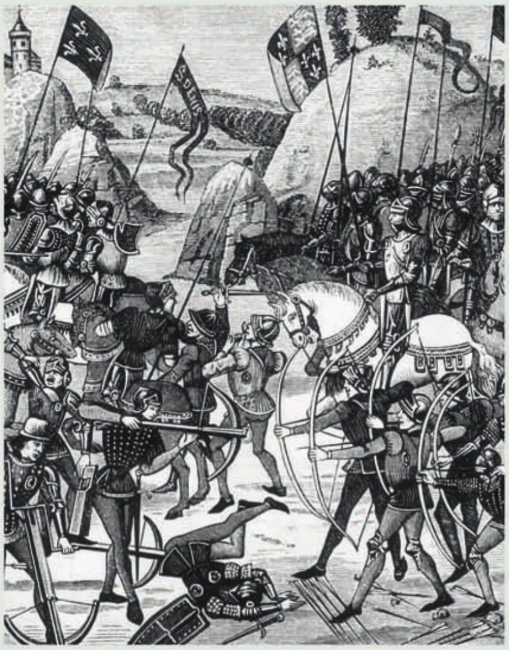
In the medieval European concept of war, foot soldiers were seen as a low-status, supporting body to mounted knights. In practice, however, when they employed tactics that made best use of their weaponry, infantry often proved decisive on the battlefield.

Most foot soldiers were either citizen militia of prosperous cities, or peasant levies forced into service by their local lords. Correspondingly, the quality of their equipment depended directly upon the money available to finance it. The well-funded infantry from the cities of Flanders – who inflicted a notable defeat upon French knights, at Courtrai in 1302 – were well protected, with mail hauberks (long mail shirts), steel helmets, shields, and gauntlets. Their weapons included bows, crossbows, pikes, and a distinctive staff weapon known as a "goedendag" – a long thick wooden staff tipped with a deadly steel spike – that functioned as both a spear and a club. Such resources were not commonly available to medieval peasant levies, however, who often entered combat without metal body armour and carrying only the simplest of spears. The success of infantry against mounted troops depended upon them fighting in a disciplined, tight formation on well-chosen ground, with natural obstacles augmented by the digging of ditches or the planting of sharp stakes.

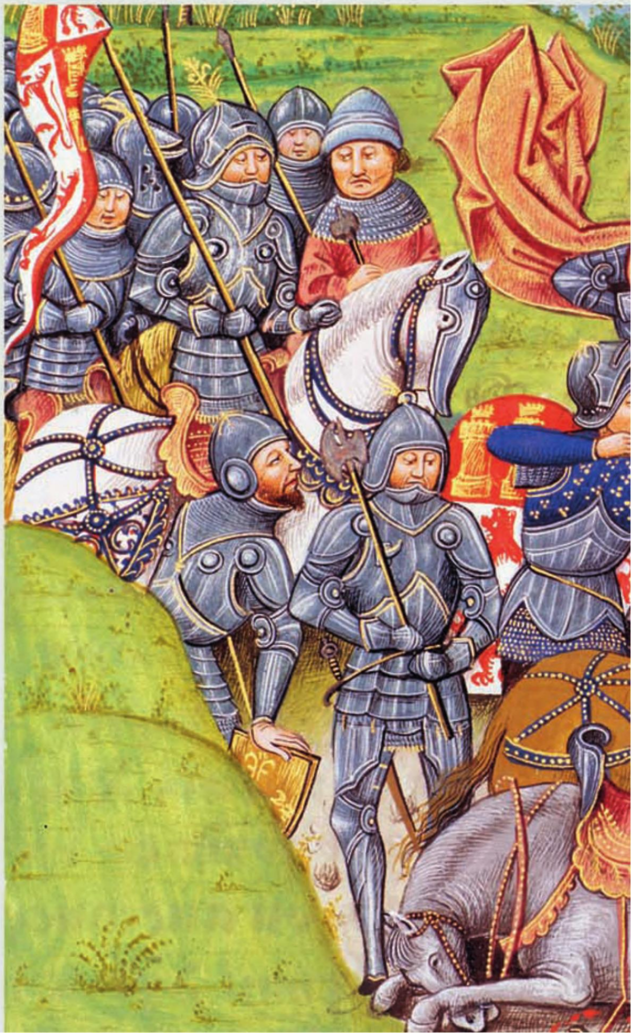
THE CROSSBOW

Bowmen were unquestionably the elite among medieval foot soldiers, and of the weapons used by these infantry, the crossbow was the most sophisticated and powerful. The bolts shot even by earlier models had been able to penetrate mail armour – among their victims was King Richard the

> "So great was the **undisciplined** violence… the **living fell on top of the dead**, and others falling on top of the living were killed"
>
> ***GESTA HENRICI***, DESCRIBING THE BATTLE OF AGINCOURT, c.1417



▸ **GENOESE CROSSBOWMEN**
Crossbowmen from Genoa, Italy, became the most sought-after mercenary soldiers in Europe, employed in particular by the kings of France. They fought in the First Crusade and other land battles as well as naval battles, continuing into the 16th century.

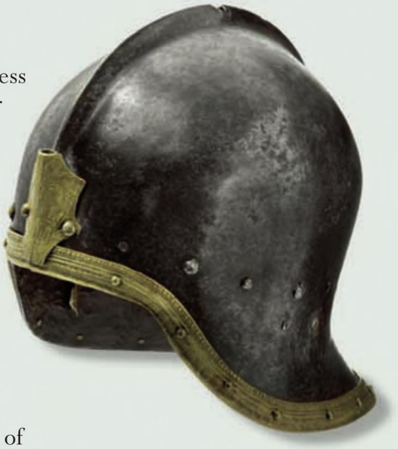


Lionheart of England in 1199. Initially, these early European models were drawn by the bowman bending forward, placing his foot in the stirrup at the end of the stock, and attaching the string to a hook on his belt; when he straightened his back, the string was drawn upwards, "spanning" the bow. From the 14th century onwards, however, mechanisms were introduced – first a windlass and pulley, and later a ratchet known as a cranequin. These systems allowed the use of composite and steel bows of even greater strength: the effect of these weapons on the battlefield was awesome.

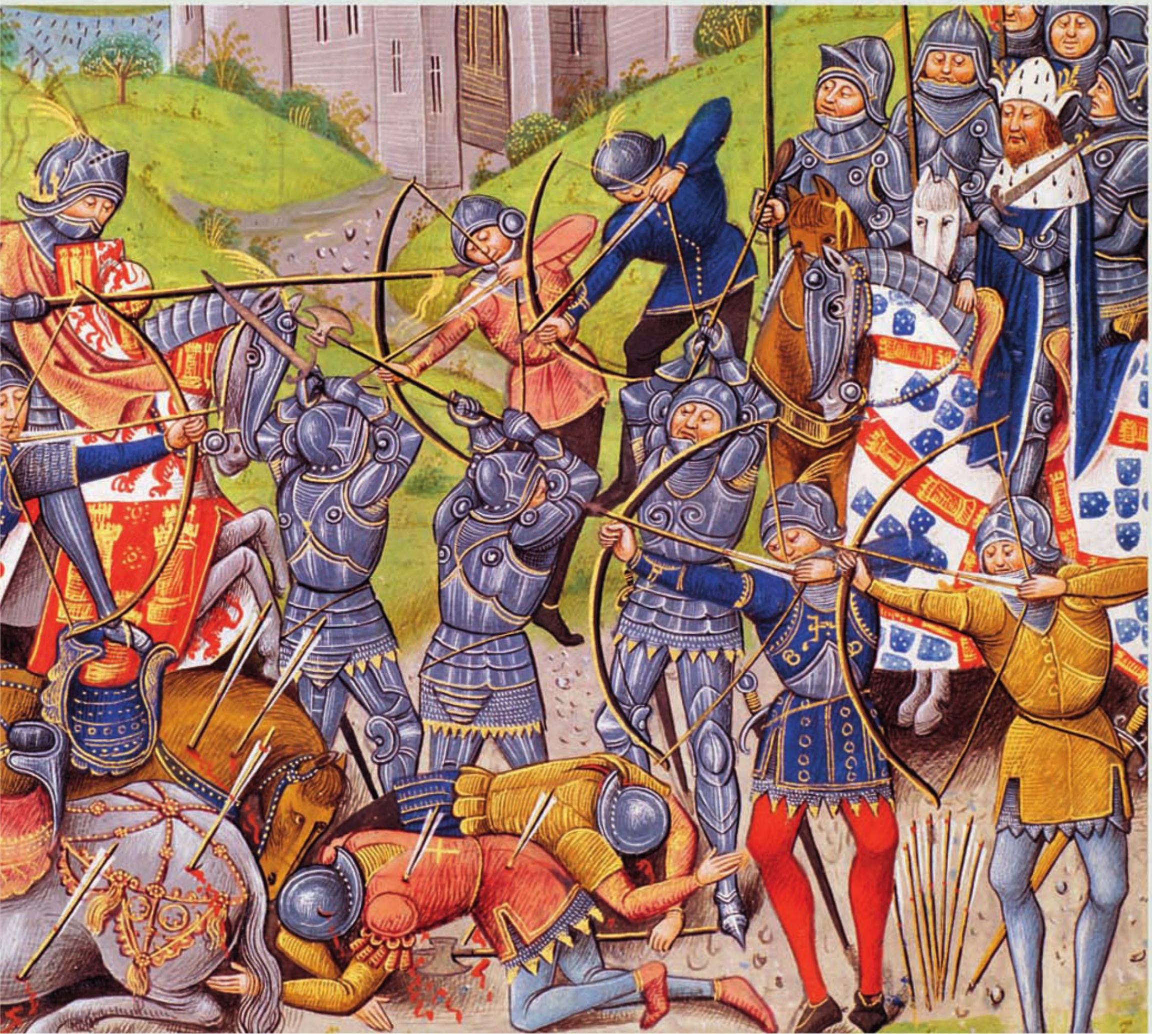
ARCHERS AND PIKEMEN

The main drawback of the crossbow, however, was its slow rate of fire. One or two shots a minute was the best an experienced bowman could manage, and the crossbow was often a more effective weapon when used in sieges than on an open battlefield. The longbow, on the other hand, made a huge impact on European battlefields when deployed *en masse* by English armies in the 14th and 15th centuries. Preferably made of yew, the "self" bow (made from a single piece of wood) required constant practice, as well as great physical strength, on the part of the archer. Its effectiveness depended upon an experienced archer who could loose around 17 arrows a minute. English kings discovered that by packing thousands of longbows onto the battlefield, they could produce a great density of fire – from a modern perspective, almost a similar effect to that of the machine-gun. The longbow saw spectacular successes in battle against the French, at Crécy in 1346, Poitiers in 1356, and Agincourt in 1415.

A demonstration of the importance of combining tactics with existing military technology was provided by the Swiss pikemen in the late 15th century. The long pike was a supremely simple weapon, but the Swiss developed a new method of using it offensively, grouping their infantry together and fighting as massed columns of pikemen advancing rapidly upon the enemy. Even more so than the introduction of gupowder weapons, their victories in the 1470s set the scene for a new era in infantry warfare.



▲ SALLET
The sallet, a form of helmet introduced in the 15th century and widely used by infantry, gave excellent protection to the neck.



◄ BOWMEN IN PITCHED BATTLE
A representation of the Battle of Aljubarotta, in 1385, shows bowmen shooting at unrealistically close range. The armour pictured is more typical of the late 15th century.

KEY **BATTLE**

THE BATTLE OF BANNOCKBURN

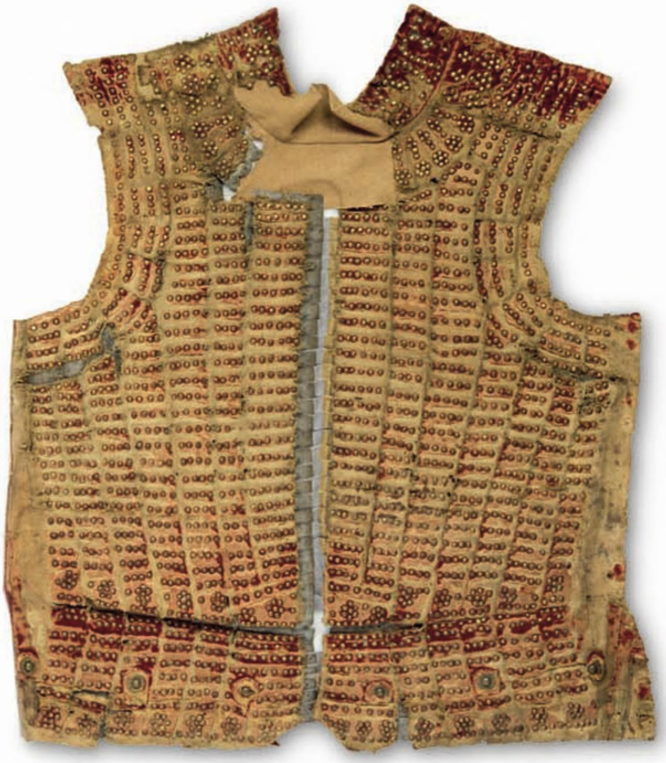
24 JUNE 1314

Fought in June 1314, Bannockburn was a famous victory for Scottish foot soldiers, led by Robert Bruce, over King Edward II's mounted English knights. The Scots took up positions on a slope above a stream. Their unarmoured soldiers formed a schiltron – a tight unit bristling with spears. The schiltron held off repeated charges by the English knights, before eventually driving them from the field in disarray.

▲ A modern illustration gives an impression of the chaos of fallen horses and knights at Bannockburn.

INFANTRY ARMOUR AND WEAPONS

At the start of the Middle Ages, foot soldiers, armed with spears and axes, played an important role on the battlefield. They were gradually marginalized as mounted knights became the dominant military force, but enjoyed a resurgence after the 13th century with the development of staff weapons such as pollaxes and bills (billhooks), which gave them a longer reach and enabled them to keep horsemen at bay. At Courtrai in 1302, a Flemish army of townspeople and peasants, armed with *godendags* (long-hafted staff weapons with a spike), defeated a French army of feudal cavalry, marking the beginning of a new golden age of infantry.



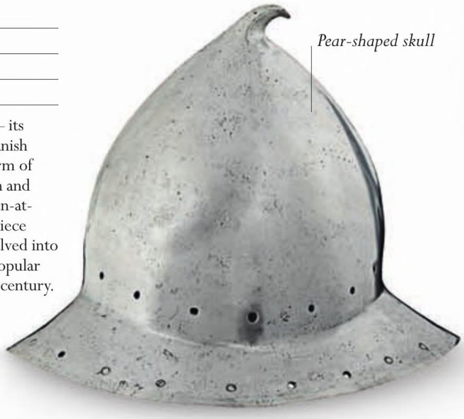
▶ CAPACETE

Date c.1470

Origin Spain

Material Steel

The capacete (or cabasset) – its name deriving from the Spanish *cabeza*, or "head" – was a form of "kettle" hat worn by Spanish and Portuguese infantry and men-at-arms. It had a conical headpiece and a narrow brim, and evolved into the "Spanish" morion, the popular infantry helmet of the 16th century.



Pear-shaped skull

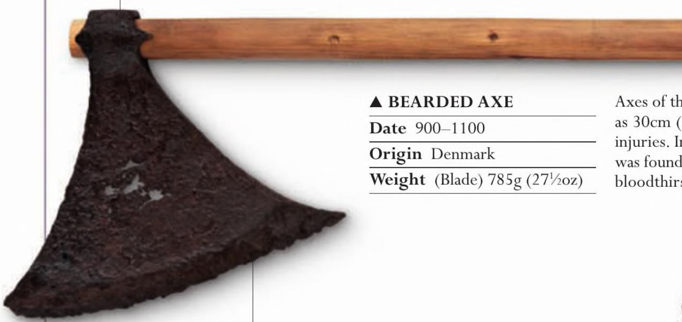
▲ BRIGANDINE

Date Early 16th century

Origin Europe

Material Canvas, velvet, steel

The brigandine became very popular among foot soldiers in bands of condottieri (mercenaries) in the 15th and 16th centuries. It was a light armour of canvas and steel plates, often covered with rich material (in this case, crimson velvet, which has largely perished).



Blade narrow at base

Long wooden shaft

Wide curved cutting edge

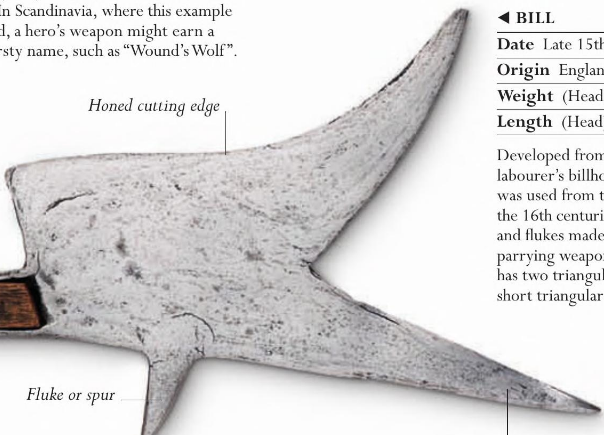
▲ BEARDED AXE

Date 900–1100

Origin Denmark

Weight (Blade) 785g (27½oz)

Axes of this period had broad blades – as long as 30cm (12in) – that could inflict terrible injuries. In Scandinavia, where this example was found, a hero's weapon might earn a bloodthirsty name, such as "Wound's Wolf".



Honed cutting edge

Tapered shaft for a tight fit

Fluke or spur

Triangular spike

◀ BILL

Date Late 15th century

Origin England

Weight (Head) 2.3kg (5lb)

Length (Head) 49cm (19¼in)

Developed from the rural labourer's billhook, the bill was used from the 10th to the 16th centuries. The spikes and flukes made it an effective parrying weapon. This example has two triangular spikes and a short triangular fluke.

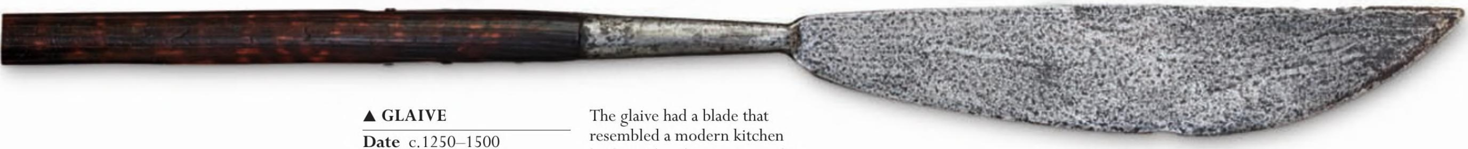
▼ POLLAXE

Date 1470

Origin France

Length (Head) 32cm (12½in)

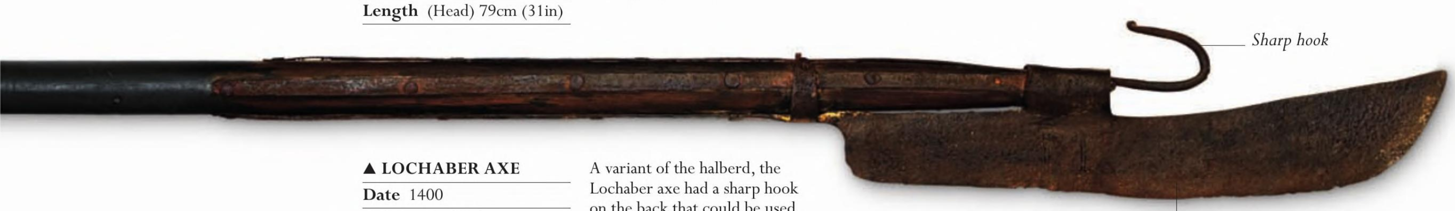
The pollaxe had multiple blades: the spike for thrusting, the axe blade for cutting through armour, and the hammer head for crushing tissue and bones. It was used both by pure infantry and, from around 1350, by knights fighting on foot.



▲ GLAIVE

Date	c.1250–1500
Origin	Scotland
Weight	2.7kg (6lb)
Length	(Head) 79cm (31in)

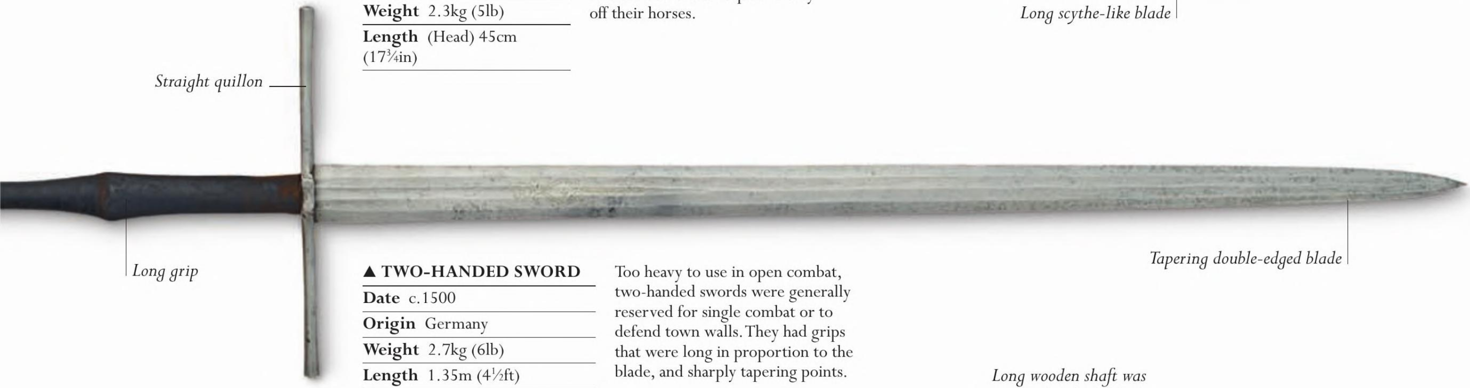
The glaive had a blade that resembled a modern kitchen knife, with a sharp point at the end, as well as a wider, curved cutting edge.


Sharp hook
Long scythe-like blade

▲ LOCHABER AXE

Date	1400
Origin	Scotland
Weight	2.3kg (5lb)
Length	(Head) 45cm (17¾in)

A variant of the halberd, the Lochaber axe had a sharp hook on the back that could be used in close combat or to pull cavalry off their horses.


Straight quillon
Long grip
Tapering double-edged blade

▲ TWO-HANDED SWORD

Date	c.1500
Origin	Germany
Weight	2.7kg (6lb)
Length	1.35m (4½ft)

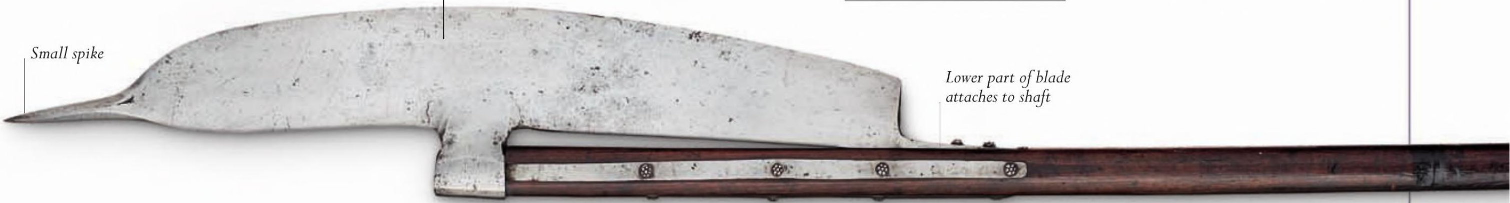
Too heavy to use in open combat, two-handed swords were generally reserved for single combat or to defend town walls. They had grips that were long in proportion to the blade, and sharply tapering points.

Long wooden shaft was gripped in both hands
Spearhead

▲ PIKE

Date	c.1500
Origin	Germany
Weight	(Head) 57g (2oz)
Length	4–5m (13–16½ft)

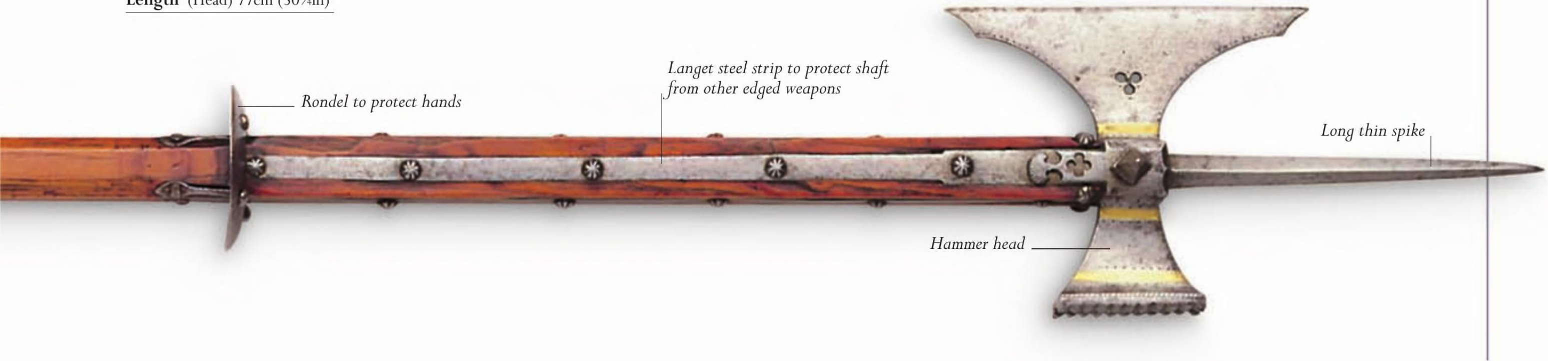
Evolving from a long infantryman's spear, the pike kept getting longer until the 15th century, when the Swiss began using them in formations. As with the hoplite phalanxes of Ancient Greece (see pp.24–25), these units were almost impenetrable to cavalry.


Long curved blade
Small spike
Lower part of blade attaches to shaft

▲ BARDICHE

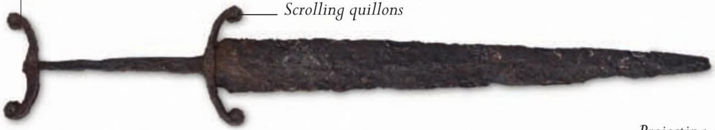
Date	c.1580
Origin	Russia
Weight	2.5kg (5½lb)
Length	(Head) 77cm (30¼in)

The bardiche was popular in Scandinavia, Eastern Europe, and Russia. It had a long narrow blade with no lugs or hooks (unlike halberds). The lower end of the axehead was attached to the wooden shaft.


Rondel to protect hands
Langet steel strip to protect shaft from other edged weapons
Long thin spike
Hammer head

MEDIEVAL ARCHERS

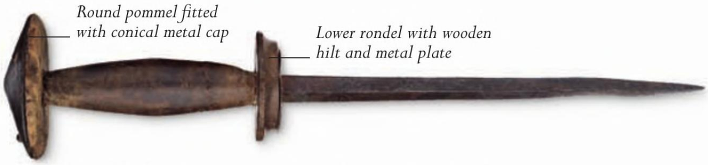
Armies up to the Middle Ages made good use of archers, although the simple bows they used made firepower relatively limited. Crossbows became common for a time in the 12th and 13th centuries, but by the mid-14th century the English, in particular, were deploying a powerful new weapon – the longbow – whose greater range enabled them to nullify the advantage the armoured knights possessed. As with most medieval men-at-arms, the archers used a range of daggers to defend themselves at close quarters, should their volleys be insufficient to drive off attackers.


Pommel curling backwards around rivet
Scrolling quillons

▲ QUILLON DAGGER

Date	14th century
Origin	England
Weight	110g (4oz)
Length	30.8cm (12in)

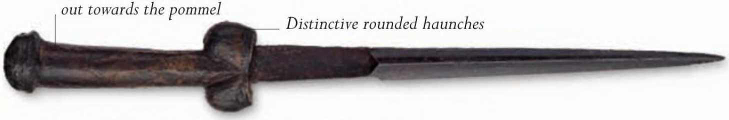
This dagger has prominent quillons that curve down towards its blade. Its atypical pommel exhibits a similar curved effect, mirroring the quillons. Such daggers were especially popular with men of high rank, particularly when wearing civilian dress.


Round pommel fitted with conical metal cap
Lower rondel with wooden hilt and metal plate

▲ RONDEL DAGGER

Date	15th century
Origin	England
Weight	230g (8oz)
Length	35cm (13¾in)

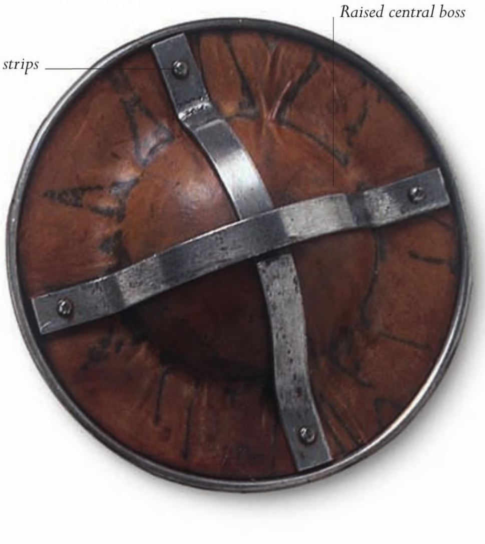
The rondel was the main military dagger during the early 15th century, distinguished by the round discs that formed the guard and the pommel. It was also known as the *dague à rouelles*, and was a popular dagger among those of high social status.


Cylindrical grip flaring out towards the pommel
Distinctive rounded haunches

▲ BALLOCK DAGGER

Date	c.1500
Origin	England
Weight	170g (6oz)
Length	34.9cm (13¾in)

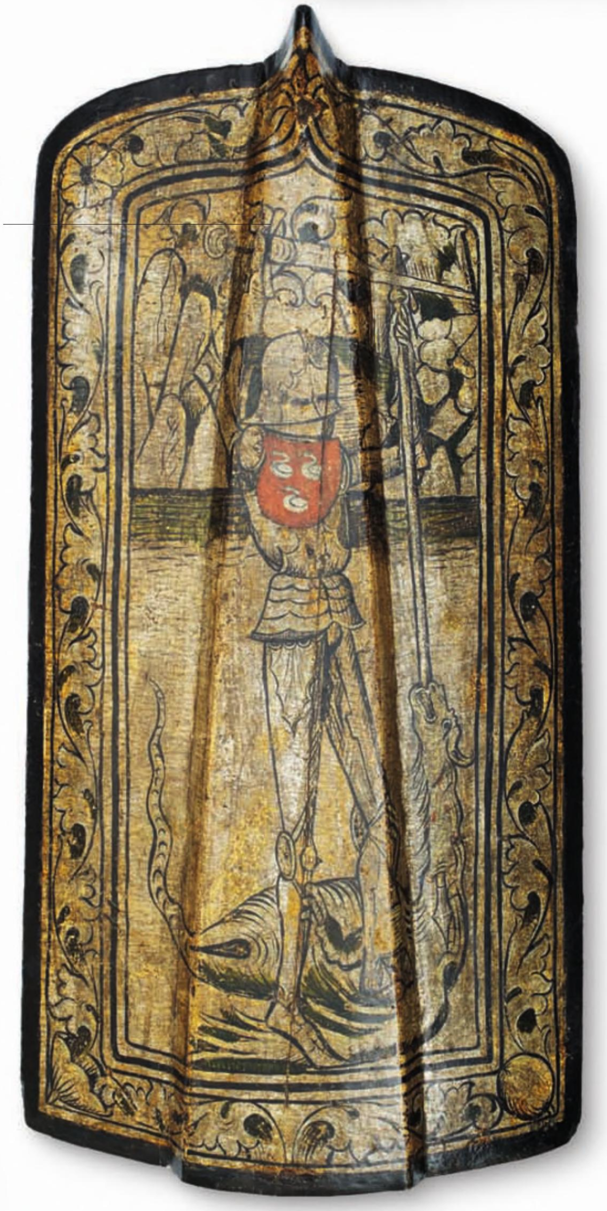
Also known as a "kidney dagger", this weapon was named after the distinctive shape of its guard with two rounded lobes. It was popular in England and the Low Countries, and was most commonly worn with civilian dress rather than armour.


Raised central boss
Reinforcing metal strips

▶ BUCKLER

Date	c.1500
Origin	Europe
Diameter	15–45cm (6–18in)

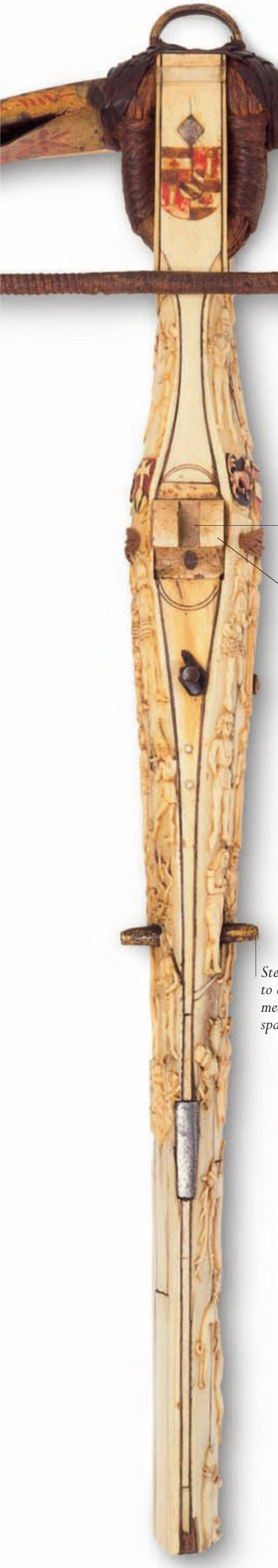
The buckler, a small round shield, formed part of an archer's equipment for hand-to-hand combat. It was capable of deflecting light blows from maces or swords, while the raised central boss – as seen on this modern replica – could itself be used as a weapon to strike against an opponent.


Projecting gutter rising to a peak offered extra protection

▲ PAVISE

Date	Mid-15th century
Origin	Bohemia
Weight	9.7kg (21¼lb)
Length	1.13m (3¾ft)

Pavises (named after the Italian city of Pavia) were long convex wooden shields often used to protect archers, and crossbowmen in particular, as their slow rate of fire made them particularly vulnerable. This one formed part of a set of 40 ordered by the Swiss city of Zwickau, in 1441.


Composite prod or lath
Bowstring of twisted cord
Groove for bolt
Revolving nut released by trigger below
Steel pin to engage mechanism for spanning bow

▲ CROSSBOW

Date	c.1460
Origin	Europe
Weight	4.4kg (9¾lb)
Length	72cm (28¼in)

Widely used in Europe from the 12th century, the crossbow, when fired from the shoulder, was very effective against armoured knights (see pp.78–79). Although the bolt was released with great power, crossbows were slow to reload, so their rate of fire was far lower than longbows.

Sharp, needle-like point for penetrating armour

▶ LONGBOW

Date	c.1540
Origin	England
Weight	730g (25¾oz)
Length	2m (6½ft)

Originating in northern Europe during the "Migration Period" (c.400–800CE), the longbow came into general use only by the late 13th century. Drawn to the ear (rather than to the cheek), the superior tension of the bowstring gave increased range. A modern archer using a replica of this bow (recovered from the wreck of Henry VIII's *Mary Rose*, which sank in 1545), shot an arrow to a distance of 328m (360 yards).

Broadhead bolt

◀ CROSSBOW BOLTS

Date	c.1500
Origin	Germany
Weight	35g (1¼oz)
Length	37cm (14½in)

Shorter and heavier than longbow arrows, bolts (or quarrels) had different tips depending on the effect required. Barbed broadhead bolts were used primarily for hunting, whereas chisel-headed arrowheads were used against armoured soldiers. The tip of the bolt served as a sight when aiming.

◀ BODKIN ARROWHEAD

Date	15th century
Origin	Europe
Weight	7g (¼oz)
Length	12cm (4¾in)

With their sharp pointed ends, bodkin arrowheads could breach mail and were capable of penetrating weak points in plate armour. In battle an archer might stick such arrows in the ground in front of him for easy access.

Sharp point and edges
Barb

▶ LONGBOW ARROWS

Date	c.1520
Origin	England
Weight	42g (1½oz)
Length	75cm (29½in)

Longbow arrows, also called "clothyard" arrows (named after the standard early 14th-century length of cloth), were mass-produced in medieval England to supply the king's longbowmen. The fletching (feathers) stabilized the arrow in flight.

Nock slots around bowstring
Shaft of ash or birch

◀ BROADHEAD ARROWHEAD

Date	c.1500
Origin	Europe
Weight	28g (1oz)
Length	4.5cm (1¾in)

Broad iron arrowheads with barbs were able to inflict a deep, wide wound, and the barbs would cause terrible (often fatal) damage to the victim as they sliced through body tissue.

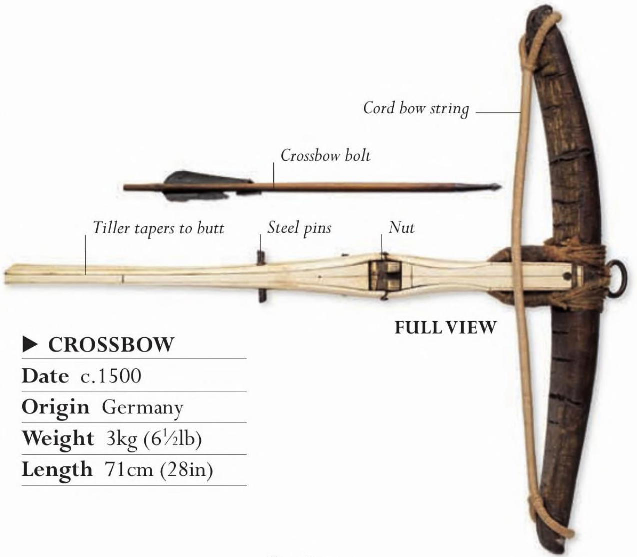
LONG RANGE POWER

CROSSBOW

This typical late medieval European crossbow could shoot a bolt roughly 300m (330 yards). Its composite bow (also known as a lath, or prod), made of layers of wood, sinew, and horn, had far too high a draw weight to be spanned by unaided muscle power – up to around 550kg (1200lb). Crossbowmen used a rack-and-pinion device known as a cranequin (also called a cric or rack) to pull the bowstring back to the nut, where it was hooked, then released it by pressing the long trigger under the crossbow tiller. The crossbowman rested the butt against his shoulder, looking along the tiller and using the tip of the bolt as his sight.

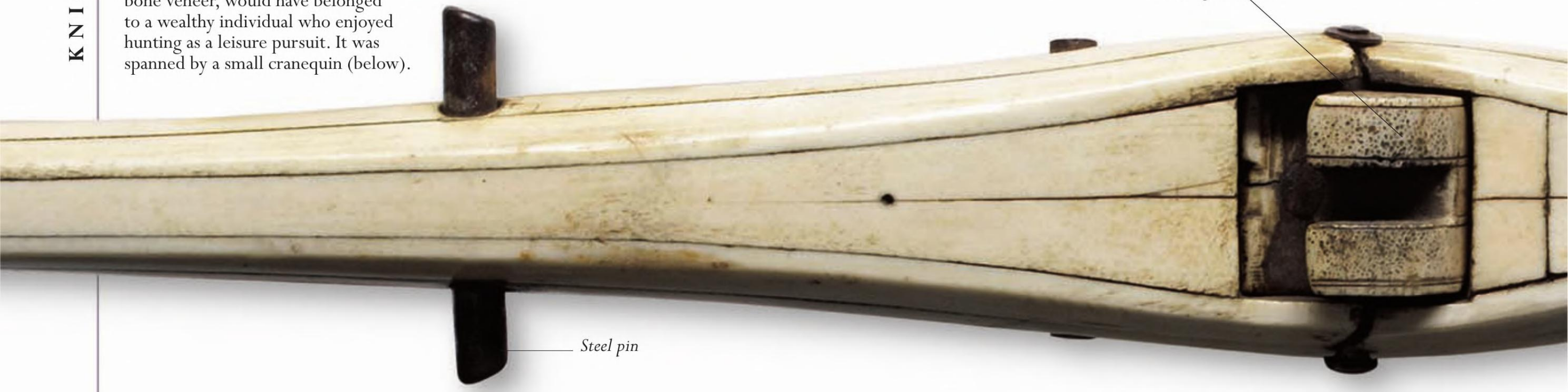
▶ CROSSBOW

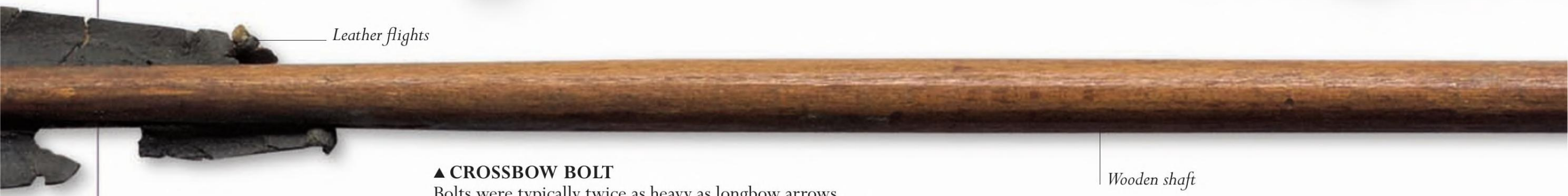
Date	c.1500
Origin	Germany
Weight	3kg (6½lb)
Length	71cm (28in)


Cord bow string
Crossbow bolt
Tiller tapers to butt
Steel pins
Nut

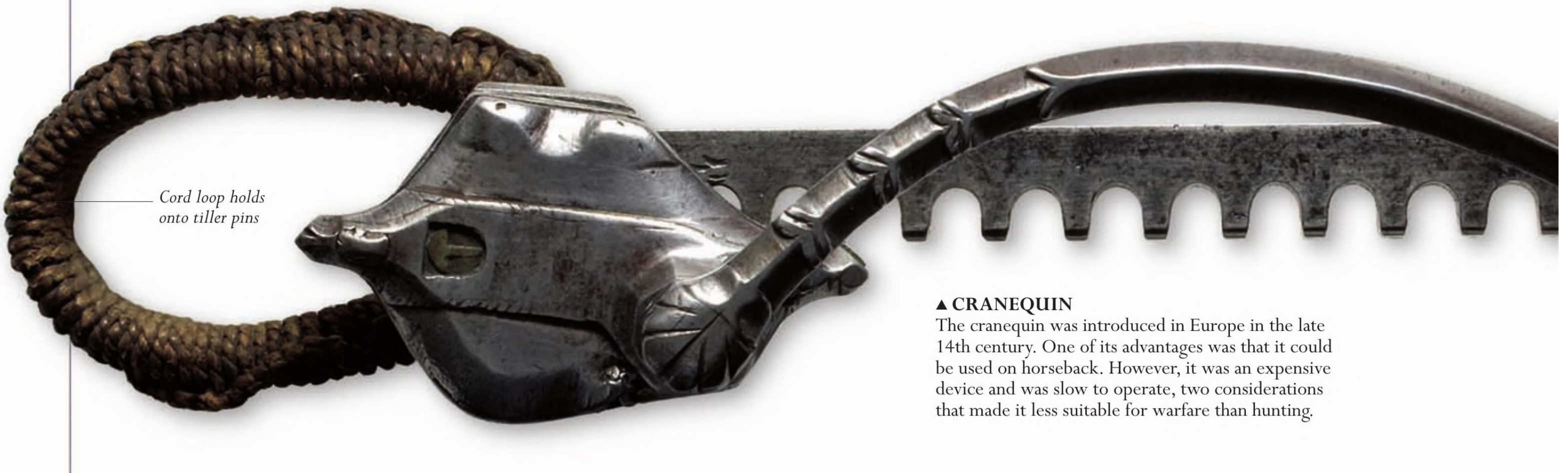
FULL VIEW

▼ CROSSBOW
This German crossbow, with its handsome bone veneer, would have belonged to a wealthy individual who enjoyed hunting as a leisure pursuit. It was spanned by a small cranequin (below).


Rotating nut
Steel pin


Leather flights
Wooden shaft

▲ CROSSBOW BOLT
Bolts were typically twice as heavy as longbow arrows. The flights were made of wood, paper, or leather, and only two were used, because a third would snag on the nut.

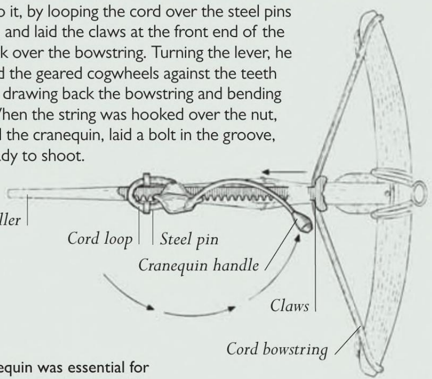

Cord loop holds onto tiller pins

▲ CRANEQUIN
The cranequin was introduced in Europe in the late 14th century. One of its advantages was that it could be used on horseback. However, it was an expensive device and was slow to operate, two considerations that made it less suitable for warfare than hunting.

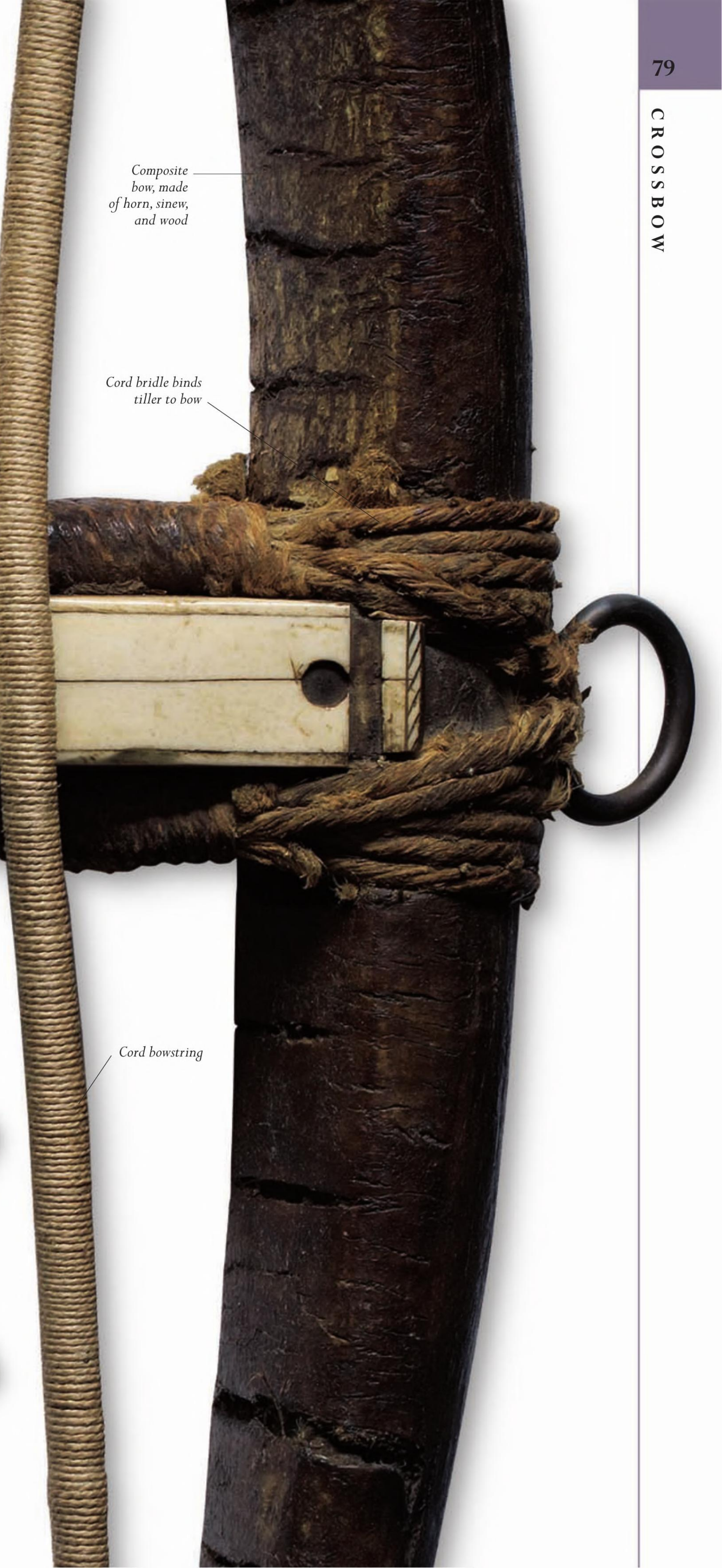
IN ACTION

LOADING THE CROSSBOW

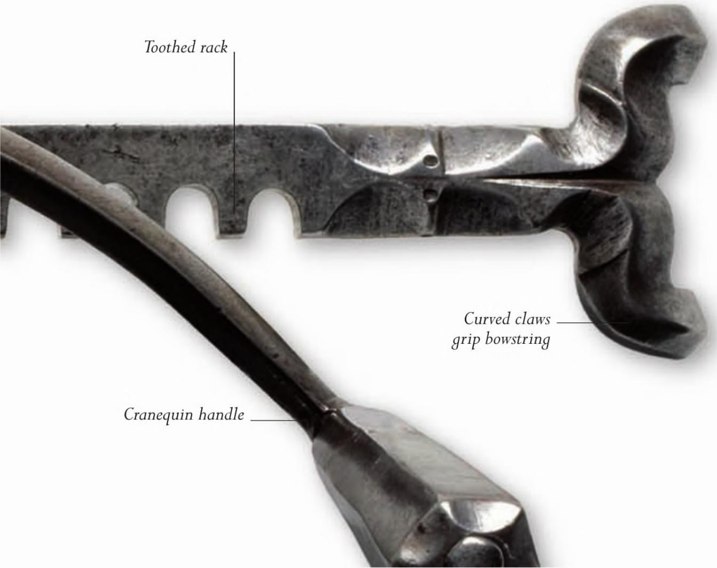
To prepare the crossbow, the archer first anchored the cranequin to it, by looping the cord over the steel pins on the tiller, and laid the claws at the front end of the toothed rack over the bowstring. Turning the lever, he then rotated the geared cogwheels against the teeth of the rack, drawing back the bowstring and bending the bow. When the string was hooked over the nut, he removed the cranequin, laid a bolt in the groove, and was ready to shoot.

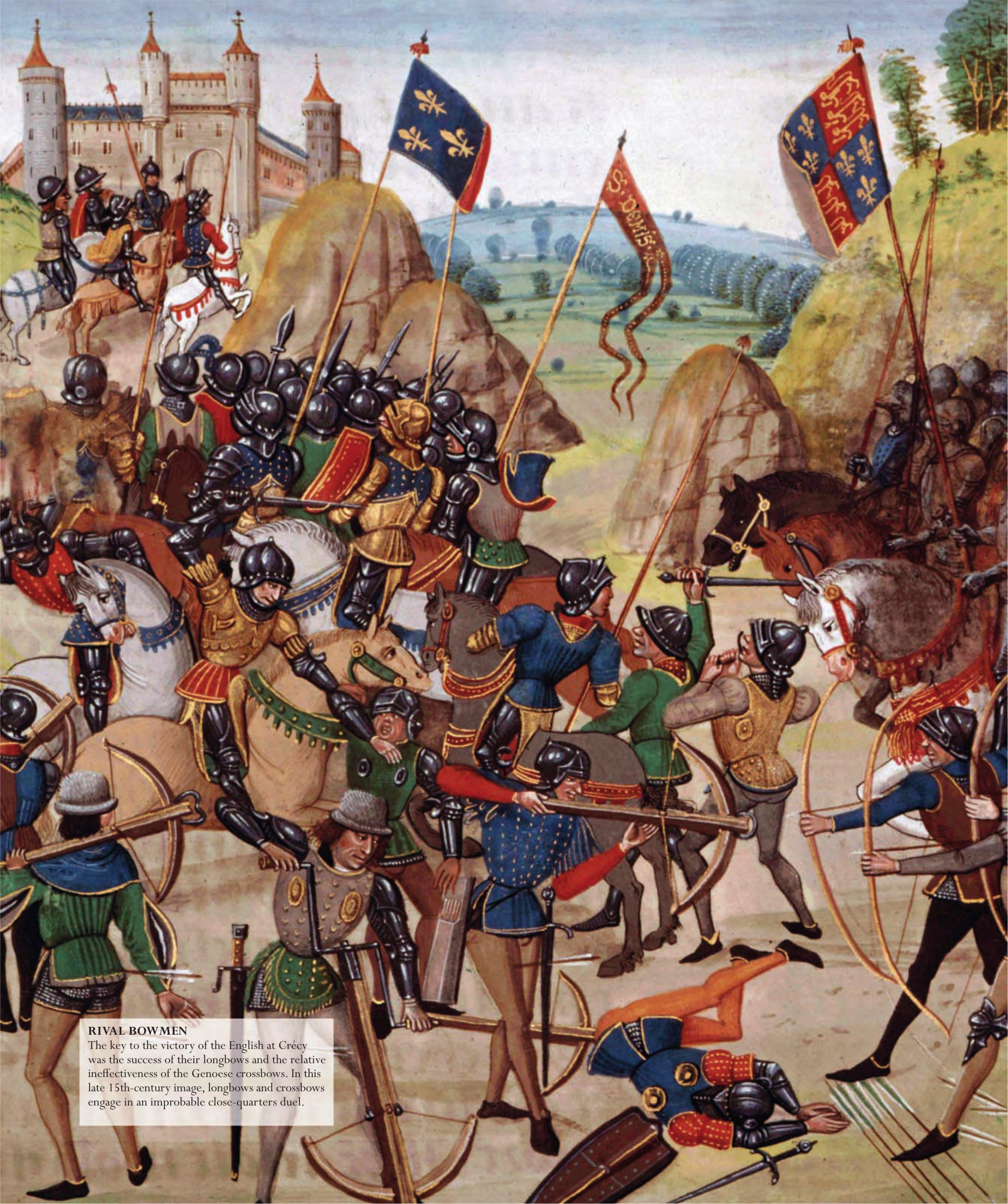

Tiller
Cord loop
Steel pin
Cranequin handle
Claws
Cord bowstring

▶ The cranequin was essential for pulling the powerful draw-weight.

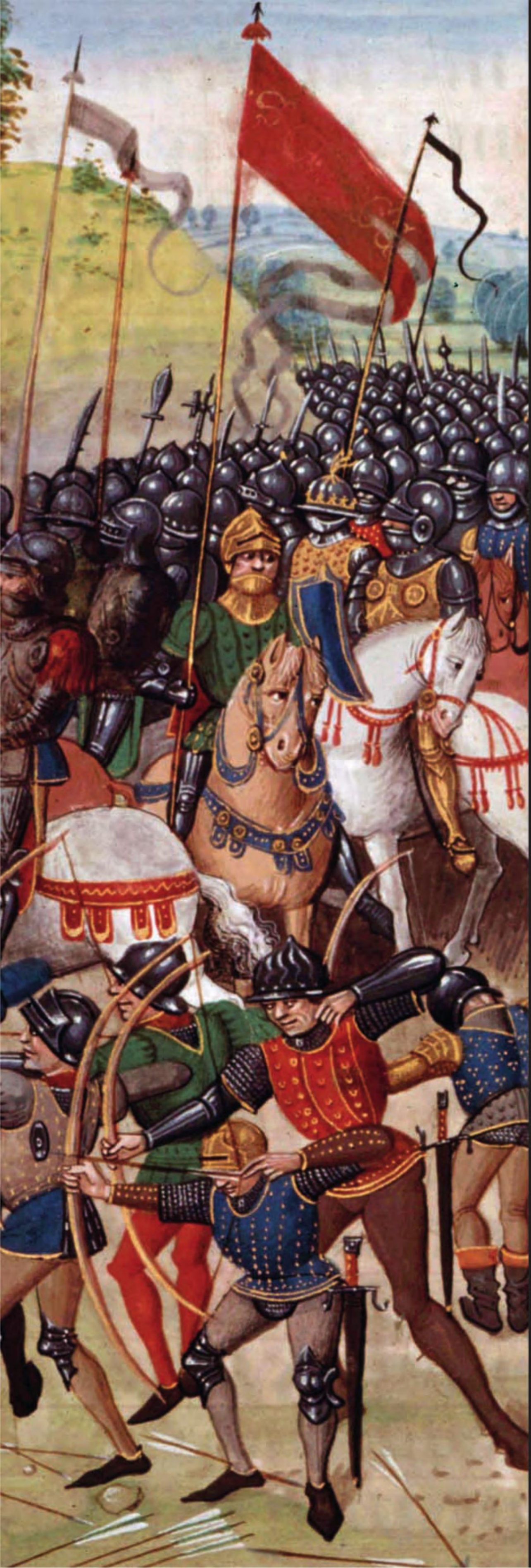

Composite bow, made of horn, sinew, and wood
Cord bridle binds tiller to bow
Cord bowstring

Triangular metal head


Toothed rack
Curved claws grip bowstring
Cranequin handle



RIVAL BOWMEN
The key to the victory of the English at Crécy was the success of their longbows and the relative ineffectiveness of the Genoese crossbows. In this late 15th-century image, longbows and crossbows engage in an improbable close-quarters duel.



MEDIEVAL KNIGHTS AND BOWMEN

THE BATTLE OF CRÉCY

During the Hundred Years' War – the series of conflicts fought between the kings of France and England from 1337 to 1453 – the medieval knight's dominance of the European battlefield began to wane. At Crécy in 1346, mounted armoured warriors were shot down by common bowmen.

In medieval Europe, knights and men-at-arms were a social and military elite, traditionally accorded pride of place on the battlefield. Battles were supposed to be won by thundering charges in which nobles showed their prowess at fighting on horseback. In the course of wars with the Scots in the early 14th century, however, the English had learned the effectiveness of a different set of tactics. With knights and men-at-arms deployed on foot in a primarily defensive role, they used massed archers equipped with fast-shooting longbows to wreak havoc.

LONGBOW IN THE ASCENDANT

In 1346, King Edward III of England landed in France with some 7,000 longbowmen, about 4,000 mounted knights and men-at-arms, and several thousand assorted foot soldiers. Edward also brought with him a few small cannon, some of the earliest gunpowder weapons to be used in Europe. The king of France, Philip VI, was able to field a much larger army – his knights and men-at-arms alone probably numbered 12,000. He intercepted Edward south of Calais, forcing him to give battle. The English king drew up his forces in a defensive position on a ridge between Crécy and Wadicourt, dividing his dismounted knights and men-at-arms into three divisions, or "battles".

The encounter opened with a duel between Philip's archers (Genoese mercenaries armed with crossbows) and Edward's longbowmen. The Genoese advanced and shot their crossbow bolts to little effect. As they stopped to reload – a lengthy process – the longbows responded. According to chronicler Jean Froissart: "The English archers advanced one step forward, and shot their arrows with such force and quickness, that it seemed as if it snowed."

Overwhelmed by the mass of arrows, the Genoese fell back. But discipline on the French side was poor. Their high-spirited noblemen considered themselves the finest knights in Europe, and they were more concerned with seeking personal glory than obeying their king's commands. Not waiting for orders, they began a piecemeal charge through the ranks of the fleeing Genoese. As the knights lumbered uphill, the longbow arrows brought down horses and men, reducing the charge to floundering chaos. The firing of the handful of cannon was barely noticed amid the devastation wrought by thousands of bowmen, each shooting at least five arrows a minute. Edward's infantry, armed with spears and knives, rushed forward to finish off the unhorsed Frenchmen.

The English did not enjoy an easy victory. The fighting continued beyond nightfall, the rival knights wielding their swords, maces, and war hammers in close combat. Froissart describes the French noblemen gathering their surviving followers around their individual banners to stage a gallant defence against the advancing enemy. Eventually King Philip fled the field, where more than a thousand of his knights lay dead. The superiority of massed longbows over armoured knights was to be witnessed again at Poitiers in 1356 and Agincourt in 1415 – without, however, lessening the prestige or status of the mounted elite.

KEY DEVELOPMENT

SIEGES AND THE ART OF FORTIFICATION

Castles and siege warfare flourished in the medieval period, mainly as a result of widespread insecurity and the fragmentation of political power. As the technology of siege weapons and tactics evolved, so it drove developments in the design of castles and city walls.

In the 11th century, most castles in western Europe were still made of wood and earth. When the first crusader armies from the west made their way to the Holy Land in 1096–99, they were awed by the defensive structures they found – massive stone fortifications ringed the great cities around the eastern Mediterranean, such as Constantinople and Jerusalem. During the following century, stone castles were to become the norm across western Europe, as well as in the crusader states in the east. At first these were mostly quite simple, with a tall curtain wall surrounding an elevated stone keep. This posed sufficient problems for besieging forces equipped with mangonels – stone-throwing torsion catapults inherited from the Romans. Unable to create a breach in the walls, armies mostly settled down to a long blockade.

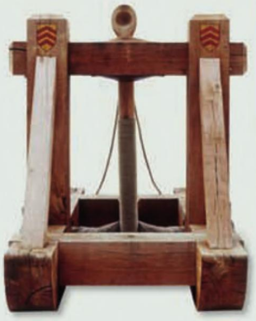
INCREASED DEFENCES

The introduction of the counterweight trebuchet in the 12th century changed the balance between besiegers and besieged. These huge machines were capable of hurling rocks weighing over 100kg (220lbs), and made curtain walls vulnerable. Castle designers responded by creating concentric structures, with the outer wall merely as a first line of defence, behind which the even taller, thicker fortifications of an inner castle loomed. Towers in the battlements were made rounded, instead of square, to deflect the force of a hurled rock. A castle was surrounded by moats – either dry or filled with water – and fortified outworks to make it difficult for the besiegers to bring up rams or siege towers. Potential weak points, especially the main gate, were reinforced with extra fortifications. Arrow slits in the walls and towers were positioned to shoot directly onto troops advancing towards, or successfully breaching, the castle.

SIEGE LOGISTICS

A medieval siege was a major undertaking, and even maintaining a blockade could stretch an army's resources. Spread out around the fortified position, besiegers were vulnerable to sudden sorties by the defenders' garrison, as well as to sniping from crossbowmen on the battlements. If mangonels and trebuchets failed to make a breach in the walls, these could be attacked with rams, or by tunnelling to undermine the foundations. A portable roof – the cat – was deployed to protect troops against missiles from above as they advanced to bring forward a ram, or hack at the wall with picks. Occasionally an assault on unbreached walls succeeded, either by scaling ladders or by rolling a tall wooden siege tower forward. More often, a weak point such as an unlocked door was discovered – or the defenders were betrayed by treachery on the part of one of their own side.

The introduction of cannon became a transforming influence on sieges during the 15th century. French superiority in gunpowder artillery enabled them to overcome a series of English stone strongholds rapidly, in the 1440s and 1450s. The stone castle was soon rendered obsolete, but another revolution in the design of fortifications would soon make sieges as long and arduous as before – the era of the angle bastion (see pp.176–77).



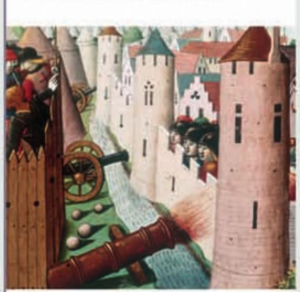
◂ MANGONEL
The catapult used the pulling power of a skein of twisted ropes. When released, the arm flew upwards and hurled the projectile at its target – often a castle's fortified walls.

KEY **BATTLE**

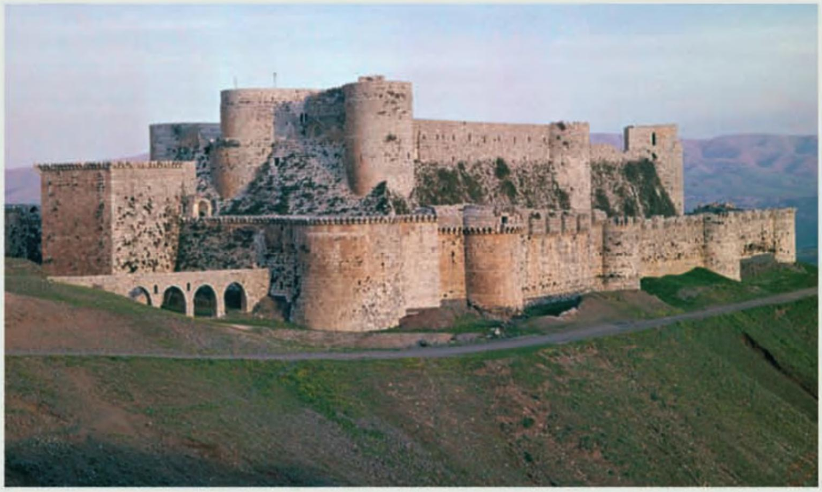
THE SIEGE OF ROUEN

1418–19

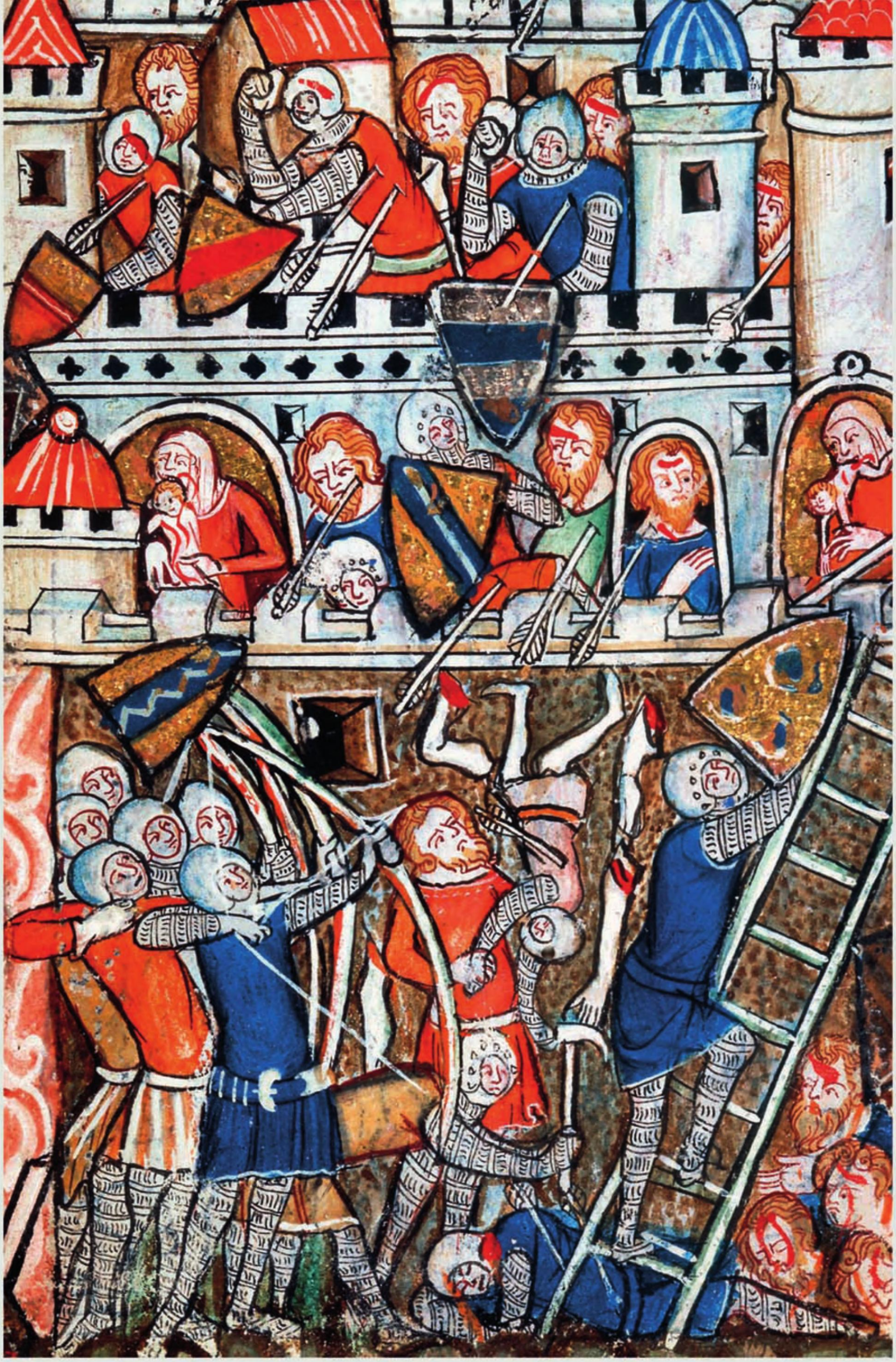
In July 1418, the city of Rouen, in France, was beseiged by an English army under King Henry V. French crossbowmen held the attackers at bay, while primitive English cannon failed to batter a breach in the well-built masonry. After six months of tight blockade, the defenders were starved into submission.



▲ Painted in around 1480, this French image of the siege shows the attackers attempting to breach the city walls with their guns.



▾ CRUSADER CASTLE
The castle of Krak des Chevaliers, of the long-standing religious and military order the Knights Hospitaller (1099–present), was considered one of the world's strongest fortresses. In 1271, it fell to Muslim leader Baybars, who used it as a base for attacks on crusader strongholds on the coast.



◄ AN ASSAULT ON FORTIFICATIONS A 14th century European artist's representation of a siege in progress shows men-at-arms in mail armour and surcoats attempting to scale walls, while archers with longbows provide covering fire. Both sides are suffering heavy casualties in this perilous assault.

KEY **EVENTS**

11TH–15TH CENTURY

- **c.1078–90** William the Conqueror builds stone keep castles in London and Rochester, England.
- **1096–99** The First Crusade introduces western European soldiers to the advanced fortifications of the eastern Mediterranean.
- **1120s–1130s** The counterweight trebuchet comes into use in battles between Muslims and Christians, in Palestine and Syria.
- **1143** The order of the Knights Hospitaller begin turning the Krak des Chevaliers, in Syria, into the most impressive crusader castle.
- **1196** Construction of Chateau Gaillard in Normandy begins – an early example of a series of high walls surrounding a central keep.
- **c.1450** Used in sieges by the French and the Ottoman Turks, cannon render medieval stone fortifications obsolete.

"The armed men… delivered a **terrific assault, firing stones and missiles**… from their **ballistas and engines**"

ITINERARIUM REGIS RICARDI, DESCRIBING THE 1191 SIEGE OF ACRE, c.1220

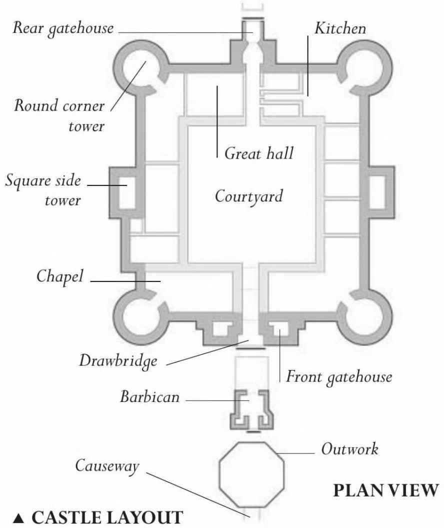
MEDIEVAL FORTIFICATION

BODIAM CASTLE

Europe's larger medieval castles were military strongholds and centres of administration. Smaller castles, such as Bodiam in southern England, were the homes of wealthy knights, built in martial styles.

Early European castles were built of wood and earth. With the adoption of stone as a construction material in the 11th century, castles became more expensive to build, but also longer lasting and more immune to fire and rot. The first stone castles had a central tower, or "keep", encircled by a defensive wall. By the time Sir Edward Dallingridge built Bodiam in 1385, towers had been integrated into the walls and the gatehouse had become the most strongly defended part of the castle.

A castle was a statement of the owner's wealth, power, and prestige, but it was also skilfully designed to give its occupants the best chance of fending off an enemy. Its walls and towers thus had to be resistant to stone-throwing siege engines and difficult for tunnel-digging engineers to undermine. However, the increasing use of gunpowder and cannon in the 15th century, eventually made the stone walls of the medieval castle obsolete, for they could not withstand battering by powerful artillery.

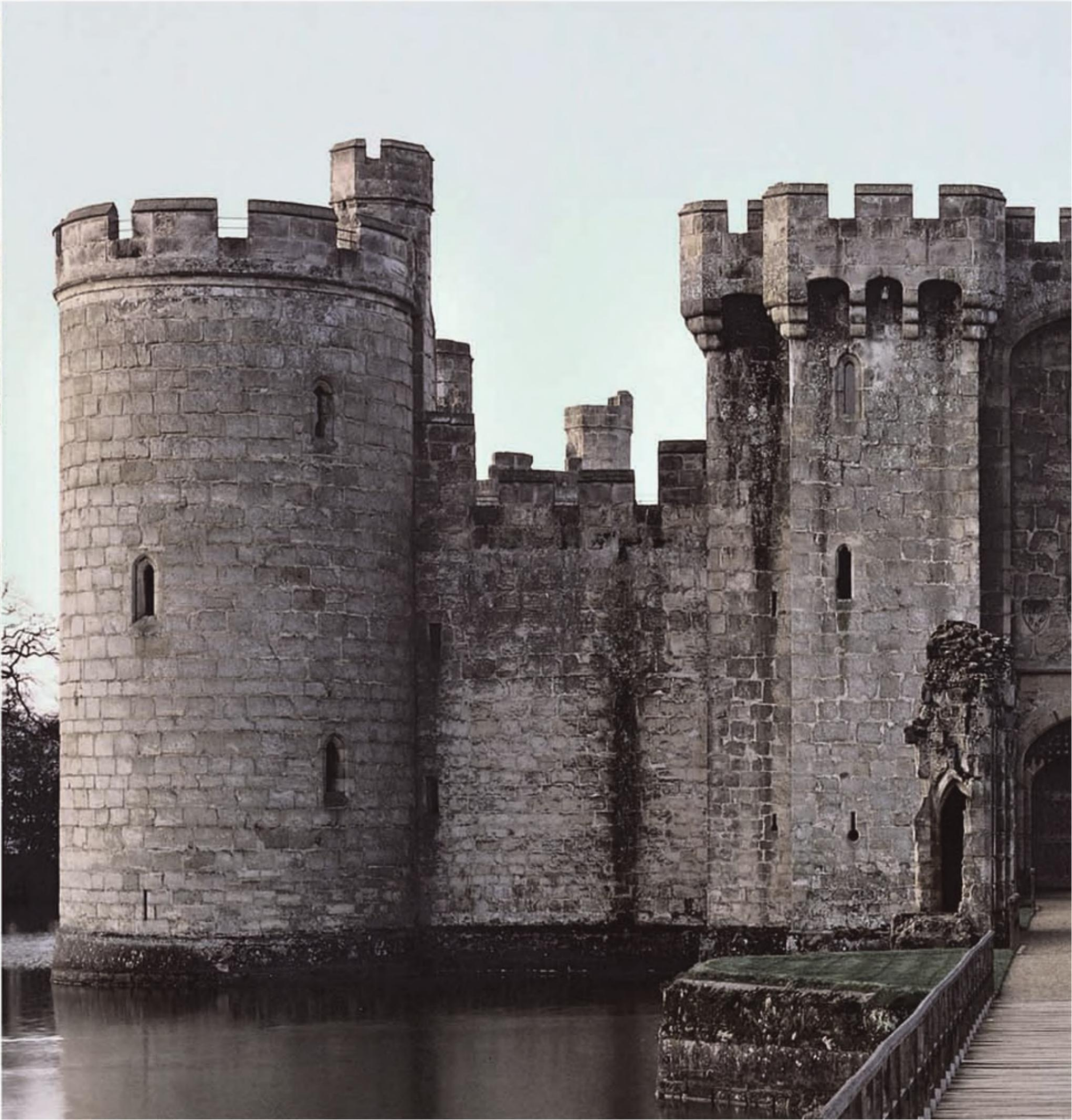


▲ CASTLE LAYOUT
Built around a courtyard, Bodiam Castle had circular towers at each corner, square towers on each side, and fortified gatehouses at the front and the back.

MAIN ENTRANCE

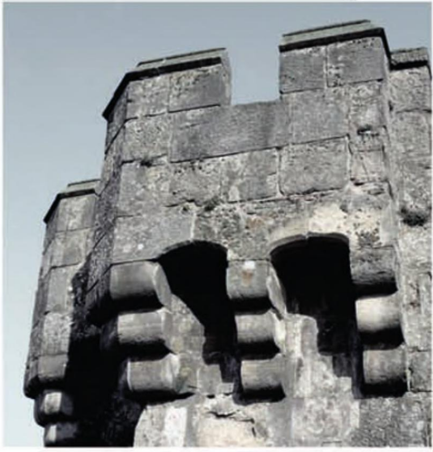
▲ MAIN GATE
A potential weak point, vulnerable to a battering ram, the gate could be protected by lowering the iron portcullis.

▲ SHIELDS OVER MAIN GATE
Heraldic shields were meant to impress visitors. The family coat of arms identified the owner and his status in the feudal order.



► SURROUNDED BY WATER
The moat forced attackers to approach the castle by the causeway at the front or a wooden bridge at the rear. It is also an impressive ornamental work that makes the castle appear larger than it really is.

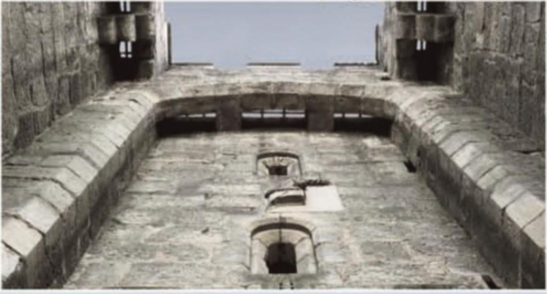
CASTLE DEFENCES



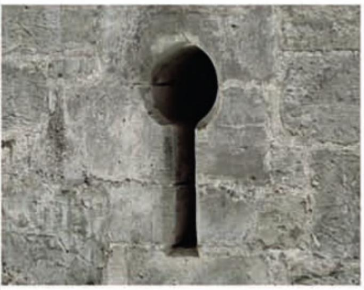
▲ **BATTLEMENTS**
Supported by projections called corbels, the castle's battlements have crenels (gaps) through which archers could take aim at attackers below.

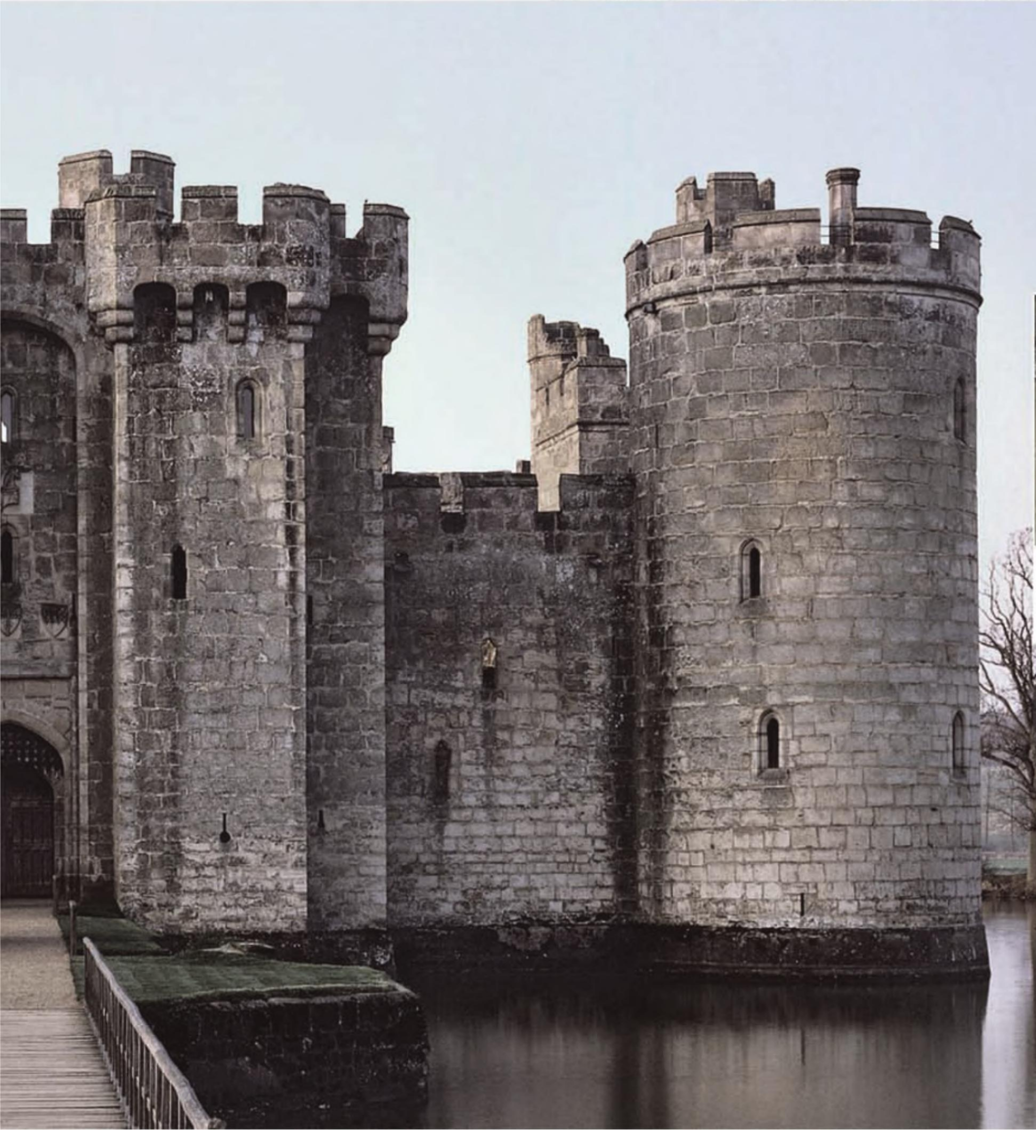
▶ **CORNER TOWER**
The round towers were excellent vantage points from which to keep watch over the surrounding land. Their curved surfaces deflected missiles hurled by siege engines.

▼ **GATEHOUSE MACHICOLATIONS**
Defenders could rain missiles onto the enemy though openings called machicolations between the battlement's corbels.

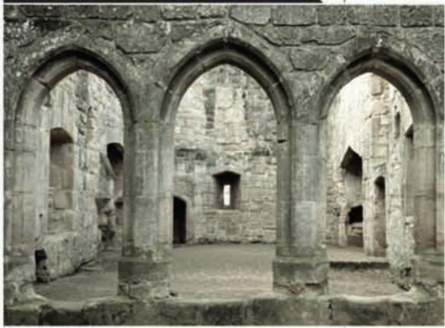


▼ **LOOPHOLE**
The walls are dotted with loopholes and arrow-slits that enabled the defenders to shoot outwards.

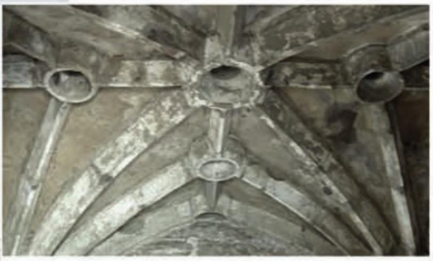




CASTLE INTERIOR



▲ **GREAT HALL WINDOWS**
The hall, the castle's main room, was designed in a contemporary Gothic fashion, with arched windows.



▲ **VAULTED CEILING**
The castle's inner chambers had elaborate ceilings, emphasizing the owner's wealth and taste.

▲ **STURDY WALLS**
Deep window embrasures (recesses) reveal the impressive thickness of the castle's outer walls.

KEY **EVENTS**

11TH–15TH CENTURY

- **1044** A document written for the Chinese emperor describes the use of gunpowder for smoke bombs and incendiary devices in sieges.
- **1231** "Fire lances" – primitive flamethrowers – and "thunder-crash bombs" are employed in the defence of Kaifeng (Beijing) against the Mongols' forces.
- **1326** The government of Florence, Italy, orders a supply of metal cannon and ammunition to be used in the defence of the city.
- **1346** King Edward III of England uses small field cannon against the French, at the Battle of Crécy.
- **c.1350** Chinese armies are regularly deploying hundreds of cannon and primitive handguns in field battles and sieges.
- **1380s** Large siege guns (bombards) come into use in Europe; some are capable of firing stone shot weighing up to 230kg (500lb).
- **1421** Using hand guns and cannon mounted on wagons, Hussites led by Jan Zizka defeat Sigismund, King of Hungary and Bohemia, at the Battle of Kutna Hora.
- **1439–53** Brothers Jean and Gaspard Bureau create a powerful artillery train for King Charles VII of France, aiding him in the defeat of the English in the Hundred Years War.
- **1453** Sultan Mehmed II of the Ottomans uses large cannon to decisive effect during the successful siege of Constantinople.

KEY DEVELOPMENT

GUNPOWDER MAKES ITS MARK

The arrival of gunpowder is often dated to 1453, when the massive cannon of Sultan Mehmed II breeched the walls of Constantinople, a city that had resisted sieges for a thousand years. However, by this time, gunpowder had already been in military use in China for four centuries.

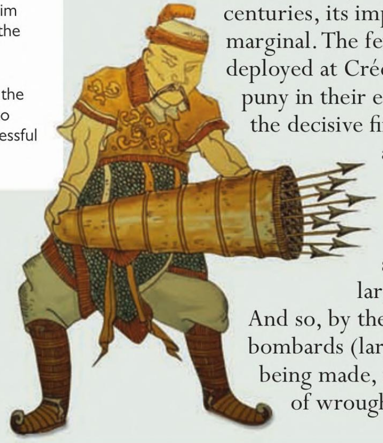
The explosive properties of a mix of charcoal, sulphur, and saltpetre were probably discovered by Chinese alchemists during the Tang dynasty (618–907CE). Documents from the Song dynasty, in the 11th century, make reference to the use of gunpowder-tipped arrows as incendiary devices, and of gunpowder fire-bombs that were hurled into besieged cities by catapult.

Over the following centuries, a whole family of gunpowder weapons was developed, from flame-throwing "fire-lances" to grenades, rockets, hand-held guns, and primitive cannon. These devices did not transform the Chinese practice of war, but took their place as a significant but subsidiary adjunct to traditional weaponry, often employed primarily for psychological effect.

THE NEW TECHNOLOGY

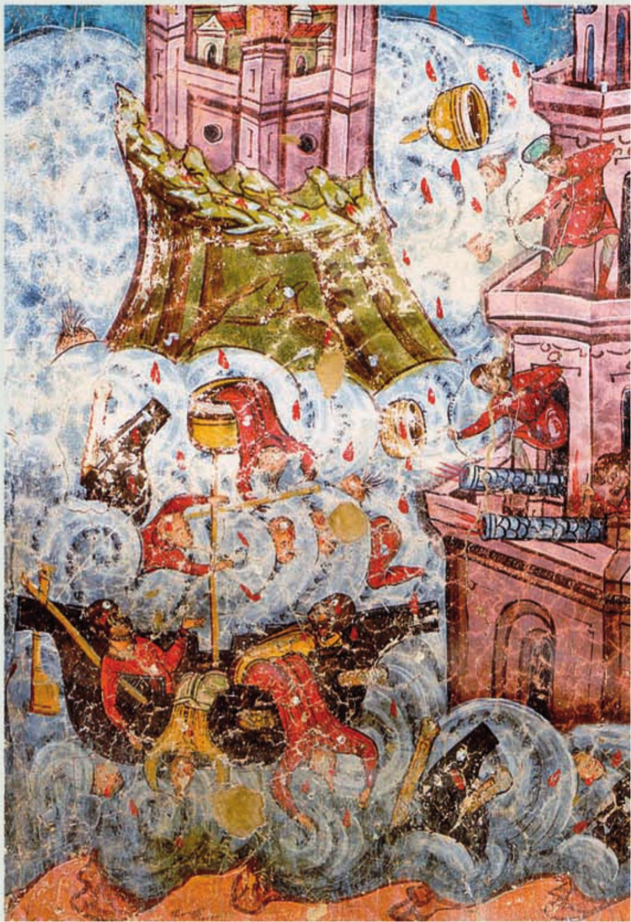
As the new gunpowder-based technology filtered through to the Muslim armies of West Asia and to Christian Europe, in the 12th and 13th centuries, its impact at first remained marginal. The few small cannon deployed at Crécy in 1346 were puny in their effect compared with the decisive firepower of the archers' longbows. However, European military artisans and their employers saw the potential of large guns for sieges. And so, by the 15th century, bombards (large siege guns) were being made, usually with barrels of wrought iron rods bound together with iron hoops. Exploiting the propulsive power of improved "corned" gunpowder, these mighty but cumbersome cannon were capable of hurling stone shot with crushing force against the walls of large structures, such as castles and towns, facilitating early siege warfare. The artillery used at the 1453 Siege of Constantinople, made for Ottoman Sultan Mehmed by a renegade Christian Hungarian artillery expert, included a bombard so large that it travelled on a cart drawn by 50 yoke of oxen and could fire a ball weighing up to half a ton.

For a brief period of time, heavy cannon were decisive weapons. At the same time that Mehmed was taking Constantinople, the French royal artillery, created by brothers Jean and Gaspard Bureau, was making a decisive contribution to the defeat of the English at the end of the Hundred



▸ **SIMPLE FIREPOWER**
Most early gunpowder weapons were crude by later standards, and did not make a great physical impact; their effect on the enemy was mainly psychological.

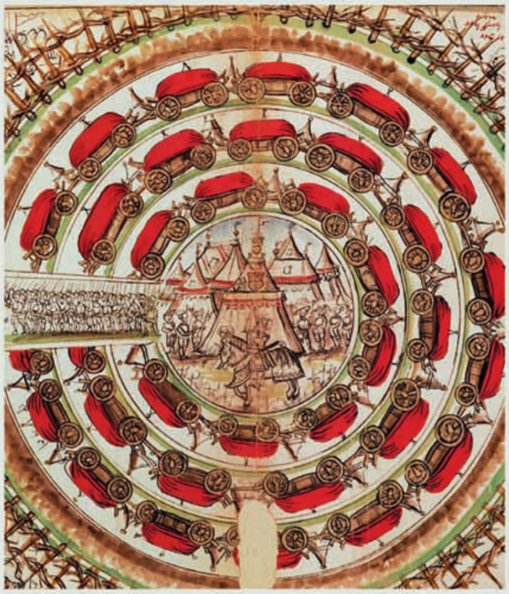
> "We can compose artificially **a fire** that can be **launched over long distances**… It is possible with it to **destroy a town or an army**"
>
> **ROGER BACON**, *OPUS MAIOR*, 1248



Years War. A revolution in fortifications, however, soon tamed the siege guns. By the 16th century, medieval castles with their tall curtain walls were being replaced by lower-lying thick-walled fortifications, with angled bastions (see pp.176–77) that provided the defenders with gun platforms to repel attack, enabling them to rake an enemy attempting an assault. Even after an additional use was found for gunpowder – packing it into a tunnel dug beneath wall, then exploding it to make a breach – besieging forces often found they could not regain the upper hand.

THE USE OF THE ARQUEBUS

A range of smaller, more mobile cannon was developed for use in field battles, along with a number of hand-held infantry and cavalry gunpowder weapons. During the 16th century, one such weapon – the arquebus, a firearm with a matchlock mechanism – equipped numbers of infantrymen in armies from western Europe to India and Japan. Slow-firing, inaccurate, and unreliable, arquebuses and the matchlock muskets that eventually succeeded them by no means dominated the battlefield, and instead coexisted with pikes, edged weapons, and crossbows. Nor did the increased use of hand-held guns and cannon make the medieval armoured knight instantly redundant. Charges by lance-wielding knights were still being executed well into the late 16th century. Instead, the adoption of firearms was a gradual process. It was only from the 1540s onwards that wheellock pistols started to become the standard equipment of the cavalryman. And it would not be until the late 17th century that all infantrymen were equipped with firearms.



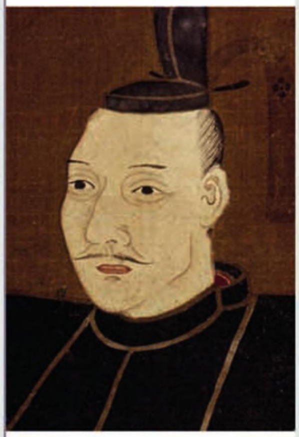
◄ **THE HUSSITE WAGENBURGEN**
Forerunners of modern armoured vehicles, these heavy carts were used to provide protection and mobility for the Hussite soldiers, who rode in them to battle armed with simple gunpowder weapons.

KEY **FIGURE**

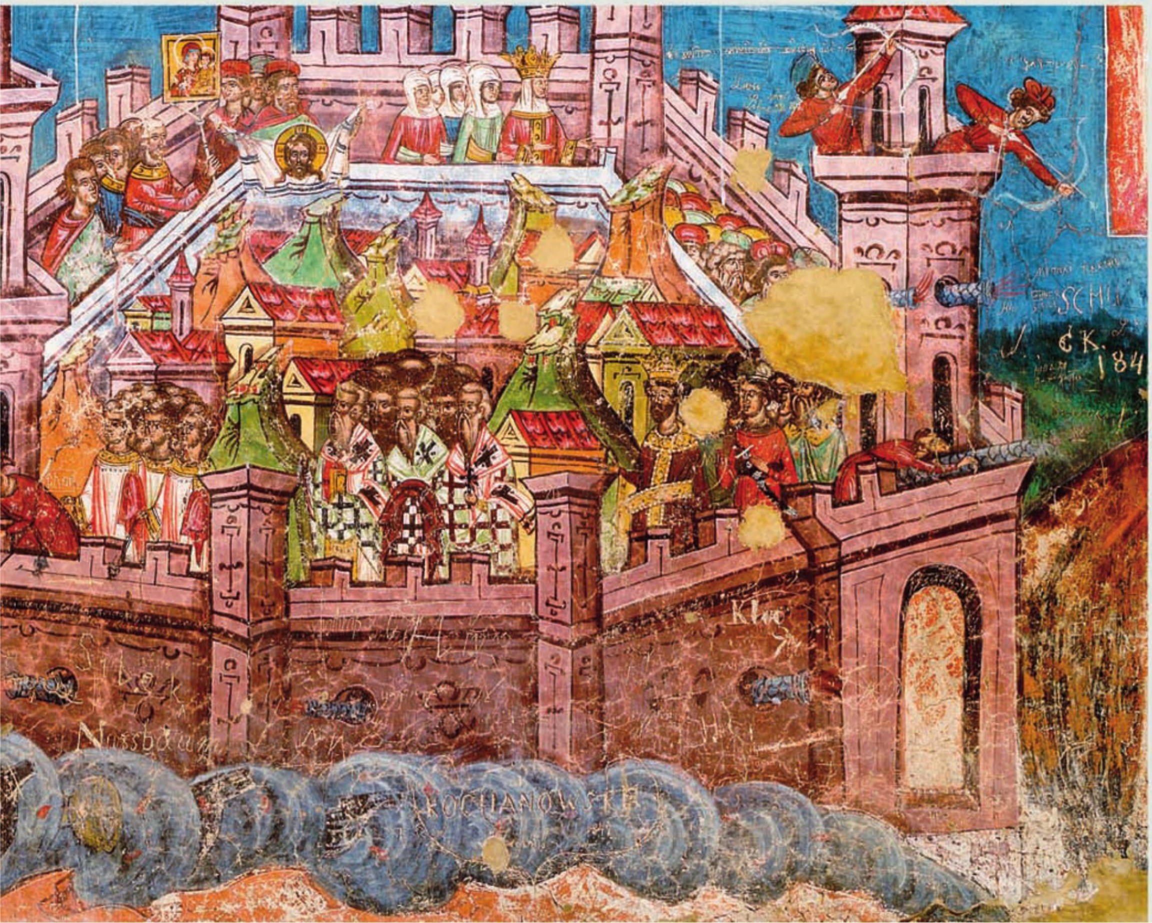
ODA NOBUNAGA

1534–82

Against the backdrop of 16th-century feudal Japan, hard-headed *daimyo* (warlord) Oda Nobunaga broke from the prevailing samurai tradition, which favoured the sword and the bow. Using volleys of arquebus fire at the Battle of Nagashino, in 1575, he defeated the rival Takeda clan, demonstrating that gunpowder could be a significant force in battle.



▲ Oda Nobunaga introduced rotating volleys of fire together with the wooden stockade for defence.



◄ **THE FALL OF CONSTANTINOPLE**
The Ottomans' powerful cannon played a large role in the capture of Constantinople and the subsequent fall of the Byzantine Empire.

SIEGE ENGINES AND EARLY CANNON

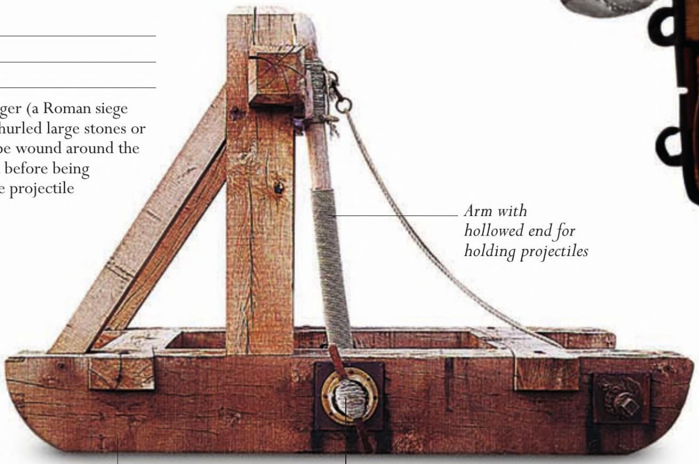
During the Middle Ages, sieges were a far more common way of conducting warfare than open battle. Powerful siege engines that could batter fortification walls were used, allowing besieging armies to breach enemy defences. The development of gunpowder weapons from the early 14th century onwards increased the psychological aspect of siege warfare – the threat of devastation from this new form of firepower could drastically shorten a siege.

▶ MANGONEL

Date Medieval

Origin Europe

A derivative of the onager (a Roman siege engine), the mangonel hurled large stones or other projectiles. A rope wound around the arm was winched tight before being released, propelling the projectile through the air.

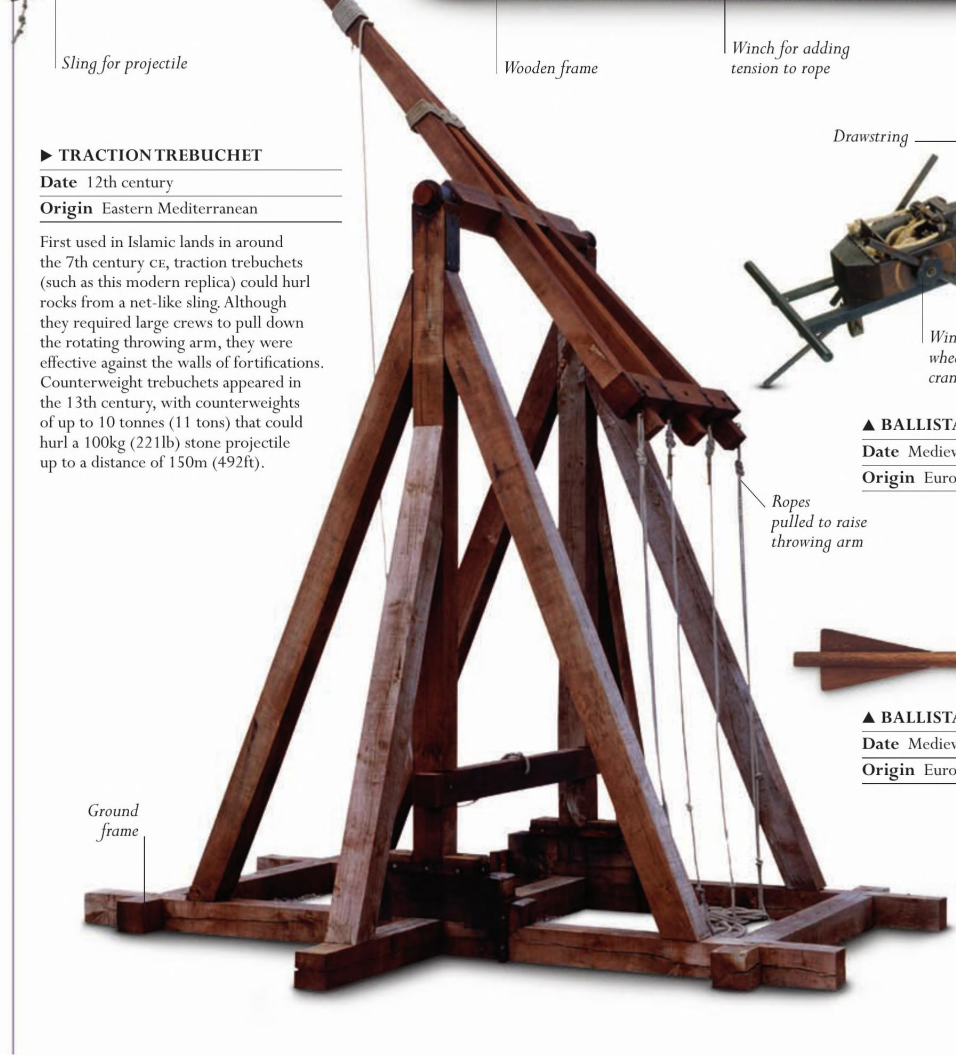

Arm with hollowed end for holding projectiles
Wooden frame
Winch for adding tension to rope

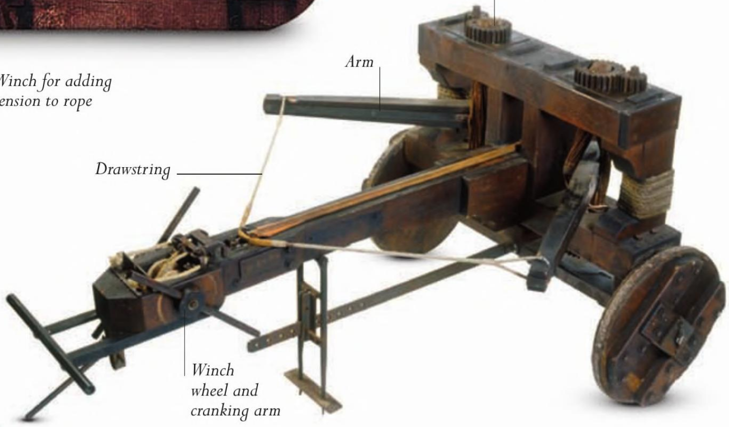
▶ TRACTION TREBUCHET

Date 12th century

Origin Eastern Mediterranean

First used in Islamic lands in around the 7th century CE, traction trebuchets (such as this modern replica) could hurl rocks from a net-like sling. Although they required large crews to pull down the rotating throwing arm, they were effective against the walls of fortifications. Counterweight trebuchets appeared in the 13th century, with counterweights of up to 10 tonnes (11 tons) that could hurl a 100kg (221lb) stone projectile up to a distance of 150m (492ft).


Throwing arm
Sling for projectile
Ropes pulled to raise throwing arm
Ground frame


Capstan
Arm
Drawstring
Winch wheel and cranking arm

▲ BALLISTA

Date Medieval

Origin Europe

Based on a weapon first developed in Greek and Roman times, the ballista was a giant crossbow with a bolt that was operated by cranking back a drawstring and then releasing the tension with a lever. It was primarily an antipersonnel weapon, rather than one designed to damage fortifications.

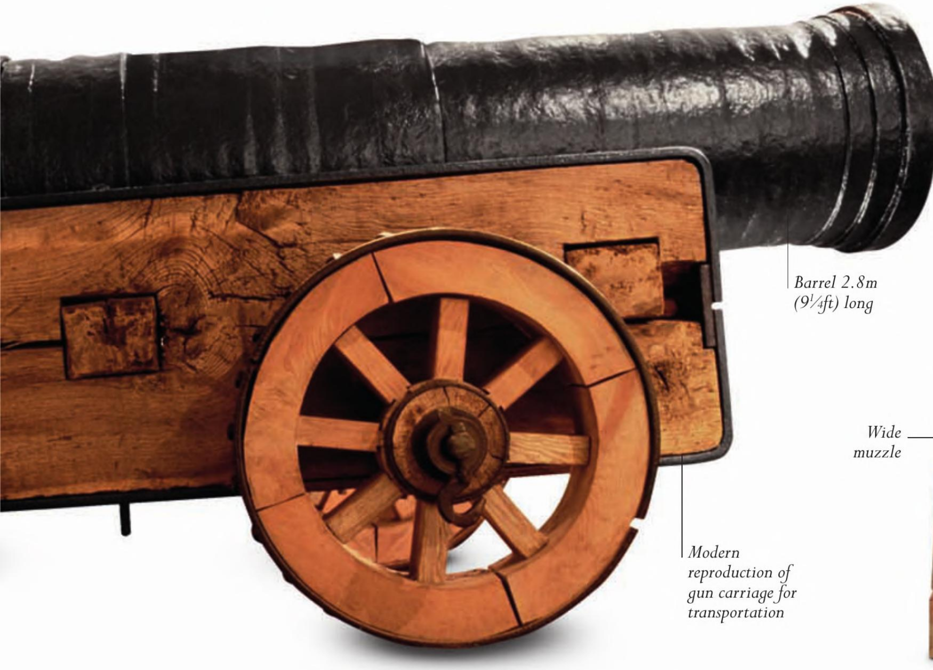
Iron arrowhead

▲ BALLISTA BOLT

Date Medieval

Origin Europe

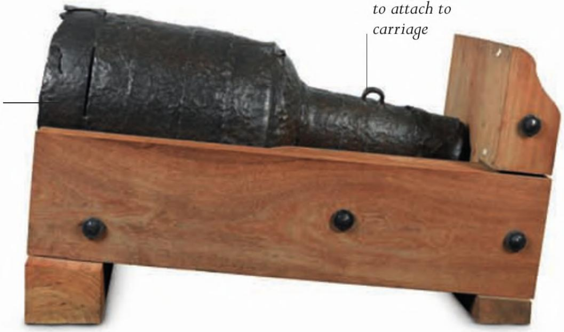
The bolts fired by a ballista catapult travelled with such force that a single bolt could pierce three men at once. The bolts were not so effective in damaging masonry however.


Barrel 2.8m (9¼ft) long
Modern reproduction of gun carriage for transportation

◀ MONS MEG

Date	1449
Origin	Flanders
Weight	5.08 tonnes (5.5 tons)
Length	4.04m (13¼ft)
Calibre	49.6cm
Range	2.61km (1½ miles)

This massive bombard was presented to James II of Scotland in 1457. It fired stone balls that weighed almost 200kg (440lb), but was too cumbersome for regular service, as it could only be moved 5km (3 miles) a day.


Fixing ring to attach to carriage
Wide muzzle

▲ MORTAR

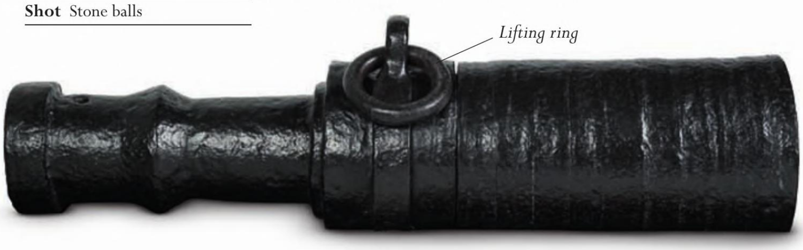
Date	15th–16th century
Origin	England
Length	1.25m (4ft)
Calibre	36cm

This mortar was found in the moat of Bodiam Castle, England (see pp.84–85). It was lit by a touch fuse at the end of the barrel, and was used to fire projectiles such as stones or perhaps incendiaries at a steep upward angle.

▼ FLEMISH BOMBARD

Date	Early 15th century
Origin	Flanders
Material	Forged hoop-and-stave iron
Shot	Stone balls

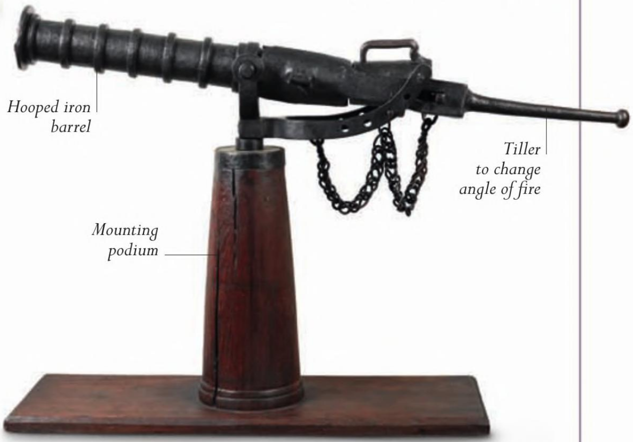
Large medieval siege guns, known as bombards, were muzzle-loaders. The stone balls they hurled were loaded through the muzzle after the powder charge. Flanders, where this bombard was made, had a strong tradition of gun-casting, particularly under Charles the Bold (1433–77).

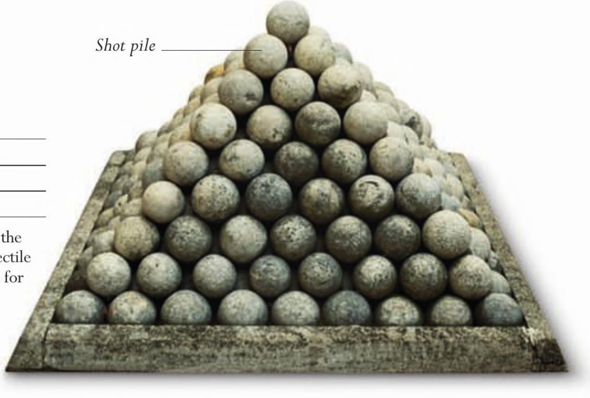

Lifting ring

▼ ENGLISH SWIVEL GUN

Date	Late 15th century
Origin	England
Length	1.36m (4½ft)
Calibre	2in

Swivel-loading guns were frequently employed for naval use. This model was mounted on the gunwales of a ship, where the superior arc of fire could be used to rake enemy vessels. Like most swivel guns, it is a breech-loader.

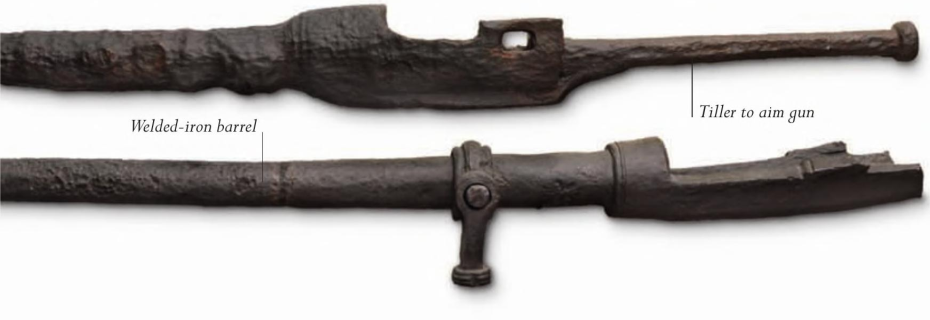

Hooped iron barrel
Tiller to change angle of fire
Mounting podium



▶ CANNONBALLS

Date	14th–16th century
Origin	Italy
Material	Stone

In the early days of artillery, the most common form of projectile was stone balls. Cannonballs for the largest bombards could weigh up to 200kg (440lb) and inflict devastating damage on city walls.


Tiller to aim gun
Welded-iron barrel

◀ SWEDISH SWIVEL GUNS

Date	c.1500
Origin	Sweden
Material	Iron
Shot	Round or grapeshot

Swivel guns first appeared in the late 14th century, providing a greater arc of fire. They were mainly breech-loading, with the pre-loaded charge placed in a chamber at the back of the bore for firing. These Swedish models would have been mounted on a boat or a building.

KEY DEVELOPMENT

ARAB AND TURKISH CONFLICT

From the 7th century CE onwards, Arab and Turkish armies dominated large areas of Asia, Africa, and Europe. These Muslim forces' military achievements were a combination of tactical subtlety, fighting spirit, and the skilled use of available weapons technology.

KEY **EVENTS**

7TH–15TH CENTURY

- **634–36CE** The Arab armies launch their campaigns of conquest, with decisive defeats of the armies of the Persian Sassanid and Christian Byzantine Empires.
- **648CE** In possession of Egypt, the Arabs begin construction of a fleet of war galleys, making them a Mediterranean naval power.
- **9th century CE** The Arab Abbasid caliphs, ruling from Baghdad, make Turkish slave soldiers the hub of their military forces.
- **1071** Seljuk Turkish horsemen outmanoeuvre and destroy a Byzantine army at Manzikert.
- **1095–1291** The Crusades ignite prolonged combat between Muslim and Christian forces in the eastern Mediterranean.
- **1396** The Ottoman Turkish army of Sultan Bayezid shows its superiority to heavily armoured European knights at the battle of Nicopolis.
- **1453** The Ottomans take Constantinople, using heavy cannon to batter the previously impregnable city walls.

The founding of Islam by the prophet Muhammad, in Arabia in the early 7th century CE, had dramatic military consequences as well as religious significance. In the century from 634CE onwards, Muslim Arab armies embarked on a series of campaigns of conquest that swept east as far as Afghanistan and west to the Iberian peninsula.

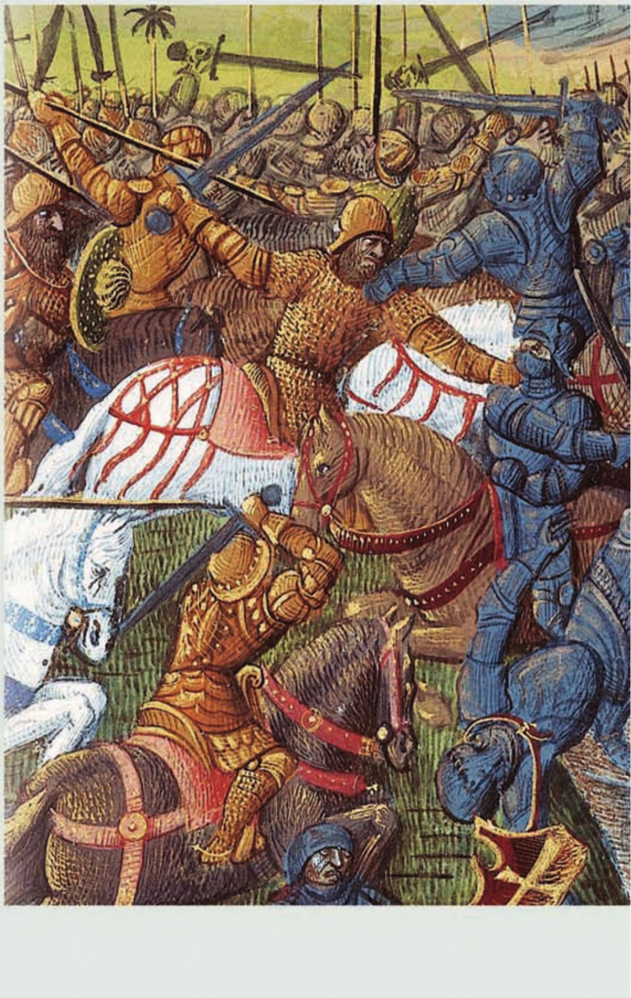
At first, the Arab military forces depended on camels to carry foot soldiers and supplies. But they quickly proved adept at absorbing new technology and tactics from the states they defeated. Soon, cavalry was the outstanding feature of Arab armies – including both light mounted bowmen and heavier armoured cavalry with spears and lances. The craftsmen of the cities they captured, meanwhile, manufactured high-quality swords; "damascene" steel, from Damascus in Syria, for example, was renowned for its resilience and cutting edge. Not previously a seafaring people, after conquering the ports of Egypt and Palestine, the Arabs developed a navy using the expertise of shipbuilders and sailors. They also adopted siege machines and tactics from the conquered Sassanid Persian Empire, and the Byzantine Empire, which they did not conquer. Muslim states later efficiently adopted such advanced siege engines as the counterweight trebuchet from their Christian enemies.

▲ **ARMOURED WARRIOR**
By the period of the Crusades (1099–1291), Muslim warriors were wearing mail and distinctive spiked helmets, such as the example shown here.

TURKISH FORCES

The migratory Turkish peoples, who inhabited large areas of central Asia, became a source of military manpower for Arab states from the 9th century CE, employed as "Mamluks" ("slave soldiers") – in effect an elite, professional standing army. By tradition, the Turks were central Asian horsemen, armed with composite bows and fighting as fast-moving light cavalry. But like the Arabs, they proved adept at absorbing useful technology and tactics from settled civilizations. During the 10th century, they began to convert to Islam and some groups, such as the Ghaznavids and the Seljuks, carved out empires for themselves, as Arab power fragmented and declined. In 1071, combined Seljuk forces led by Alp Arslan inflicted a crushing defeat on a Byzantine army at Manzikert (in modern-day Turkey) – a heavy setback, from which the Byzantine Empire never fully recovered.

The Christian invasions of the eastern Mediterranean, known as the Crusades, brought various Muslim armies into combat with forces

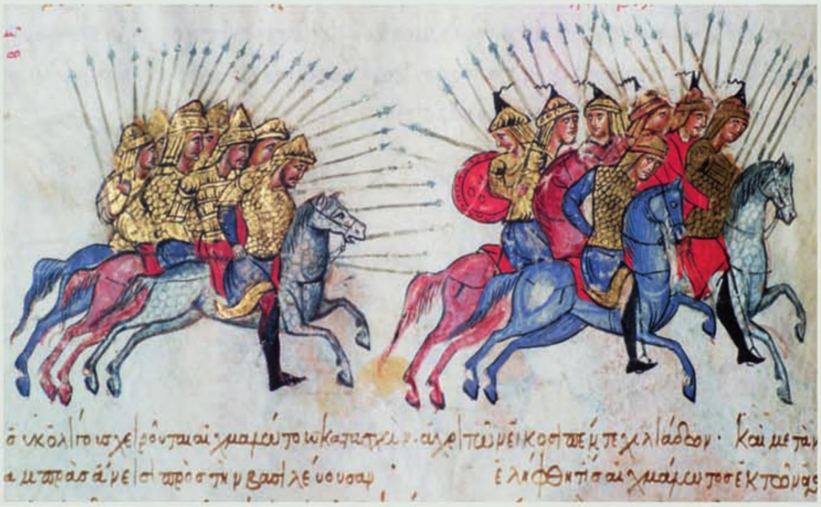


"The Turks at a **given signal** rode about them like swarms of wasps, **showering arrows upon them** from all sides"

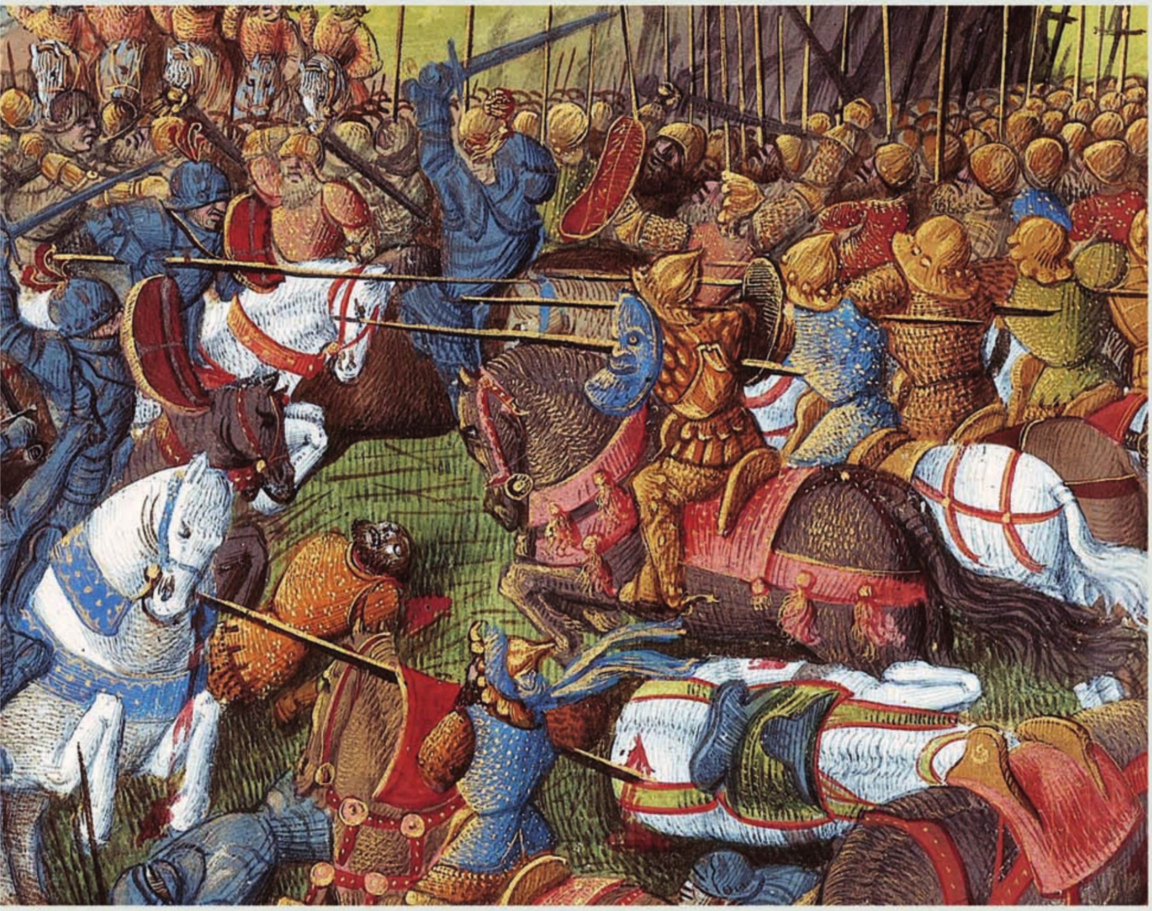
BYZANTINE HISTORIAN ANNA COMNENA, *THE ALEXIAD*, c.1140 from western Europe between the late 11th and late 13th centuries. Although more lightly armoured than the Christian knights, forces led by Saladin, Kurdish ruler of Egypt and Syria, and Baybars, Mamluk sultan of Egypt, inflicted a number of defeats on crusaders' heavily-armoured bodies of knights. The Muslim forces' flexible tactics were based on rapid manoeuvres, such as hit-and-run attacks by light horsemen, and they closed in for hand-to-hand combat only once they had gained the upper hand.

THE RISE OF THE OTTOMANS

During the course of the 14th century, a band of Turkish warriors established themselves in Anatolia, at the heart of the old Byzantine Empire. Initially led by Sultan Osman, they became known as the Ottoman Turks. Their military successes soon carried them deep into southeastern Europe. Originally mounted bowmen, the Ottomans also proved to be exceptionally quick to learn to use newer military technologies, adding gunpowder weapons to their armoury during the 15th century. Unlike other Muslim armies of the time, they also made successful use of foot soldiers as well as mounted troops. In 1453, the Ottoman sultan, Mehmed II, captured the Byzantine capital of Constantinople using cannon – a groundbreaking use of gunpowder weapons. The city went on to become the capital of the Ottoman Empire all the way until the early 20th century.



▲ **ARAB CAVALRY**
An 11th-century Byzantine illustration shows Arab mounted troops armed with spears. Their armour was usually mail, with distinctive pointed helmets and aventails, which protected the neck.



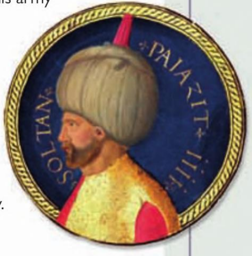
◀ **THE BATTLE OF HATTIN**
In 1187, Muslim forces led by Saladin encircled, and subsequently defeated, an army of crusader knights at Hattin in Palestine, as depicted in this 15th-century illustration.

KEY **FIGURE**

BAYEZID I

1360–1403

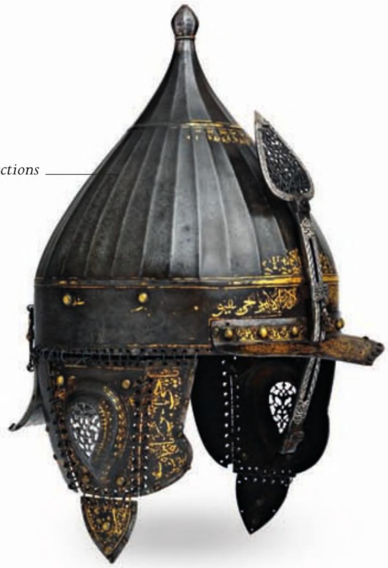
Bayezid I was sultan (leader) of the Ottoman Turks from 1389 to 1403. Through a series of aggressive campaigns, he extended Ottoman rule across the Balkans and threatened Hungary. European knights organized an army to counterattack on the Danube, but Bayezid's army slaughtered this multinational force at Nicopolis in 1396. However, he met his match in 1402, when his army faced the Tatar warlord Timur at the Battle of Ankara. The Ottomans were defeated and Bayezid was taken prisoner, later dying in captivity.



▲ Sultan Bayezid was known as "Yilderim" – "the Thunderbolt" – because of his ruthless, decisive manner of waging war.

THE MIDDLE EAST

Between the 11th and 16th centuries, the weapons and armour of the Islamic world displayed greater variation than that of their western counterparts, although the most common type of armour was a mail coat (a *dir* or *zirh*), which was similar to the mail hauberk of European knights. Islamic helmets were most often conical, egg- or turban-shaped, and of metal or organic material. Swords were generally straight and double-edged until the 11th century, when cavalry sabres appeared under Turkish influence. Islamic armies employed a large number of horse archers, as well as cavalry bearing lances and swords, while the infantry carried maces and a variety of pole-arm weapons.



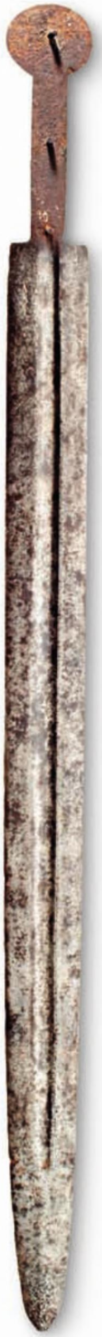
▲ ÇIÇAK HELMET

Date c.1525–1550

Origin Anatolia

Material Steel, silver, gilt

Made in the turban shape characteristic of many Islamic helmets, this parade helmet belonged to a grand vizier of the Ottoman Sultan, Suleyman the Magnificent (see p.130). It is decorated in gold with Koranic inscriptions and arabesques.



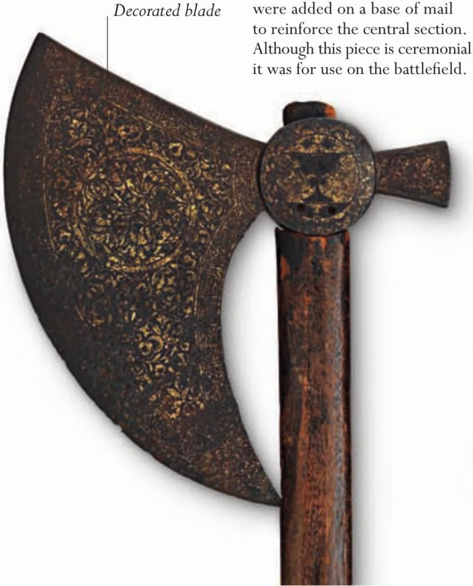
◀ ISLAMIC SWORD

Date 12th–13th century

Origin Spain or Sicily

Length 89.5cm (35in)

Most early Islamic blades were straight, rather than curved. This wide, double-edged blade with a disc-shaped pommel lacks quillons. The grip, which was probably made of leather, has also perished. The blade bears inscriptions in Persian on both sides.



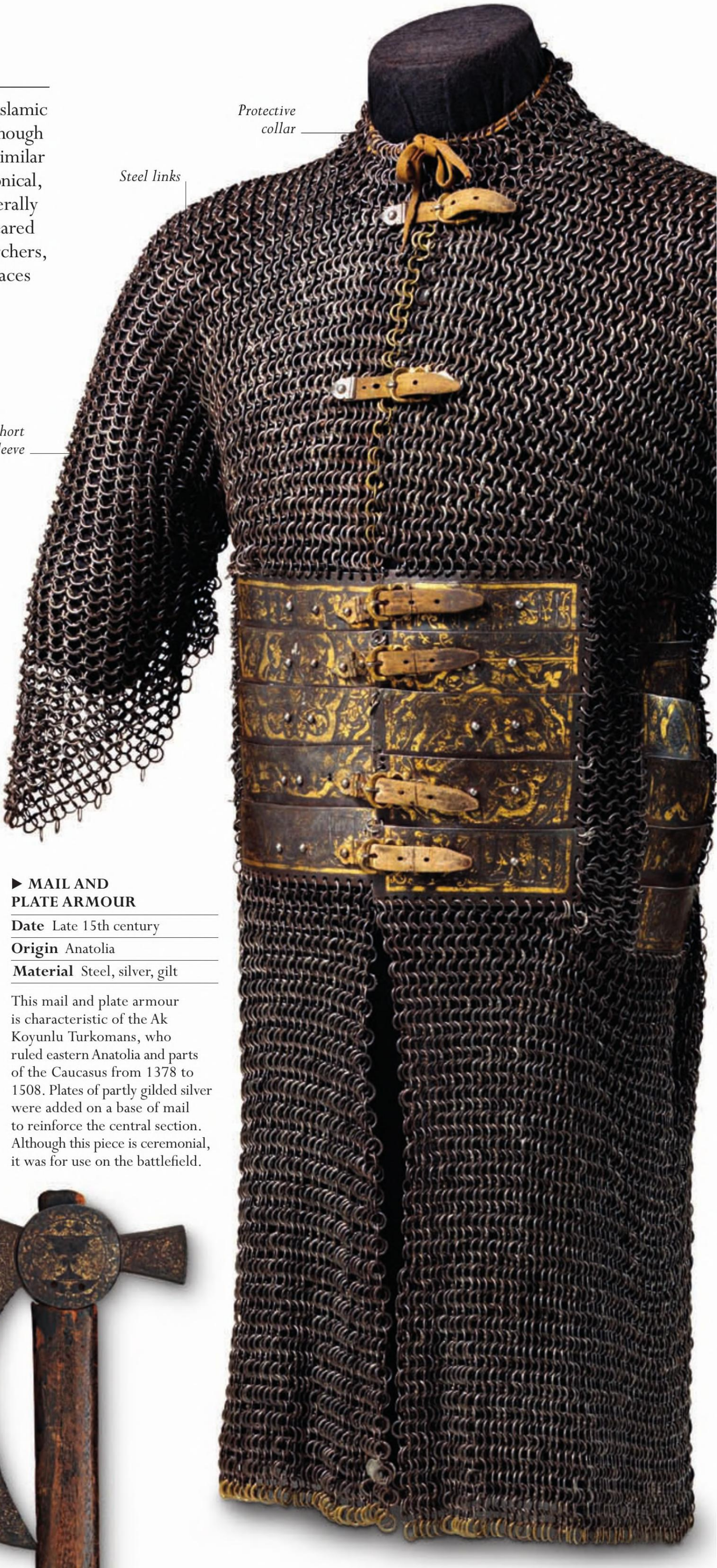
▶ MAMLUK AXE

Date c.1400

Origin Syria

Length 69cm (27in)

This ceremonial axe, with its asymmetrical, crescent-shaped blade, probably belonged to Mamluk Emir Nawruz al-Hafizi. He was executed for staging a revolt against the sultan in 1413–14.



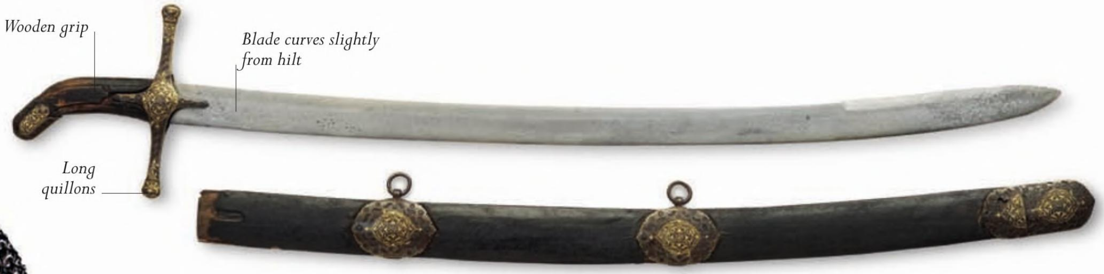
▶ MAIL AND PLATE ARMOUR

Date Late 15th century

Origin Anatolia

Material Steel, silver, gilt

This mail and plate armour is characteristic of the Ak Koyunlu Turkomans, who ruled eastern Anatolia and parts of the Caucasus from 1378 to 1508. Plates of partly gilded silver were added on a base of mail to reinforce the central section. Although this piece is ceremonial, it was for use on the battlefield.


Wooden grip
Blade curves slightly from hilt
Long quillons

◀ KILIÇ

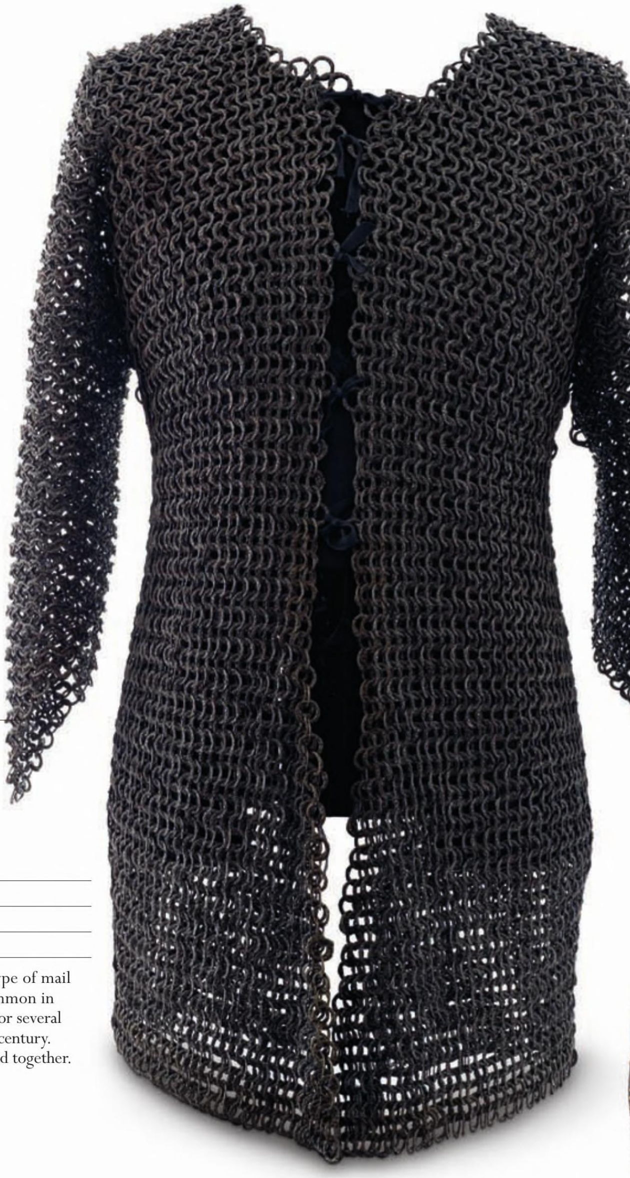
Date c.1500

Origin Anatolia

Weight 1.15kg (2½lb)

Length 95cm (37½in)

Long, single-edged cavalry sabres that curved slightly from the hilt were characteristic of Central Asian Turkic groups. Known as *kiliç*, they came into common use in the Islamic world from the 11th century.


Mail coat with long sleeves
Riveted iron rings

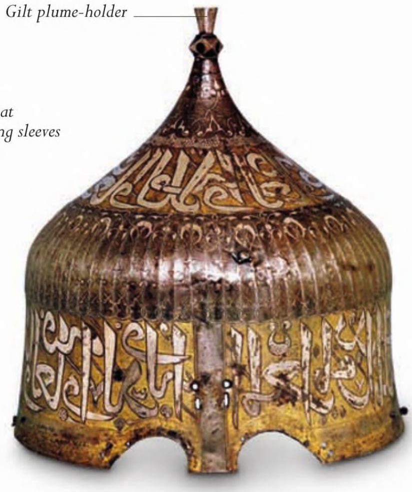
▶ MAIL SHIRT

Date Late 15th century

Origin Anatolia

Material Iron

Known as the *zirh,* this type of mail coat was particularly common in Anatolia and the Levant for several centuries before the 15th century. The iron rings were riveted together.


Gilt plume-holder

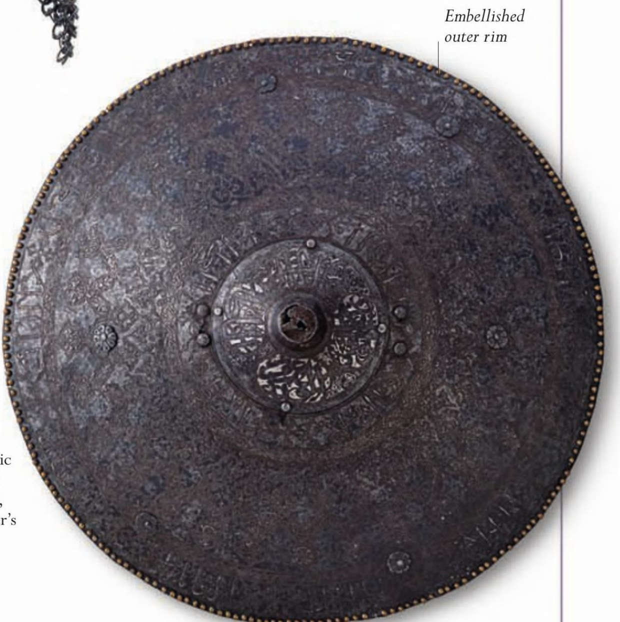
▲ MAMLUK HELMET

Date 15th century

Origin Anatolia

Material Iron

This turban-style iron helmet is typical of Mamluk protective headgear. Despite bearing a rich silver damascened inscription, it was for battlefield use, and would have been lined and fitted with a metal aventail.


Embellished outer rim

▶ ISLAMIC SHIELD

Date Late 15th century

Origin Anatolia

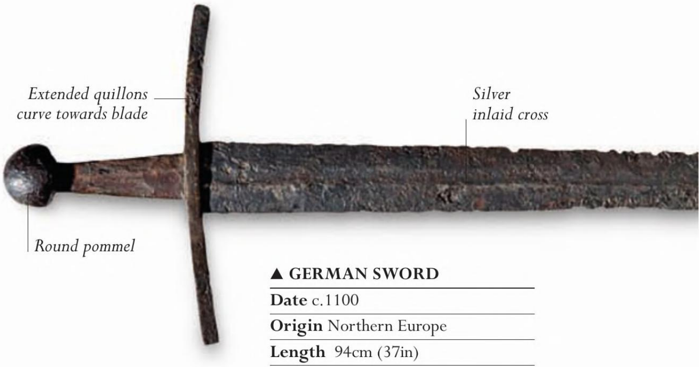
Weight 1.67kg (3½lb)

Diameter 45.8cm (18in)

This type of shield was characteristic of the cavalry of the Ak Koyunlu. It had a high steel boss and, in battle, was generally strapped to the wearer's left arm. It was embossed with a geometric pattern.

THE CRUSADES

Throughout the crusading era (from 1095 to the fall of Acre in 1291), the weapons of the knights who formed the crusading elite remained relatively unchanged. The lance played a crucial part in the shock tactic of the mass charge, but at close quarters the sword was the crusader knight's most valuable weapon. Generally straight and double-edged, it was well adapted for use against mail. Later it was complemented in the Levant by daggers – considered unchivalrous in western Europe – and in the 13th century by axes, flails, and maces.


Extended quillons curve towards blade
Silver inlaid cross
Round pommel

▲ GERMAN SWORD

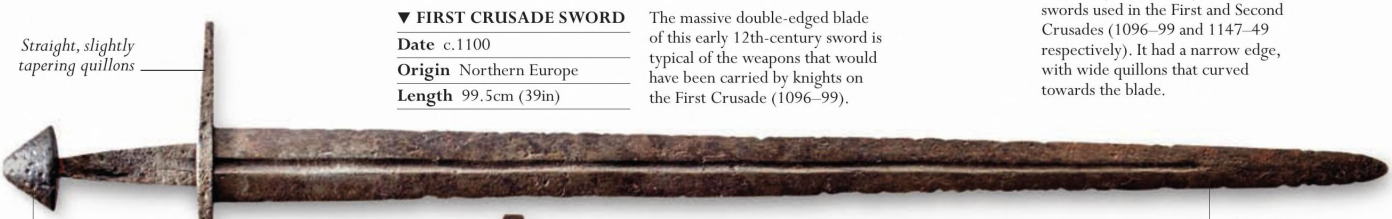
Date c.1100
Origin Northern Europe
Length 94cm (37in)

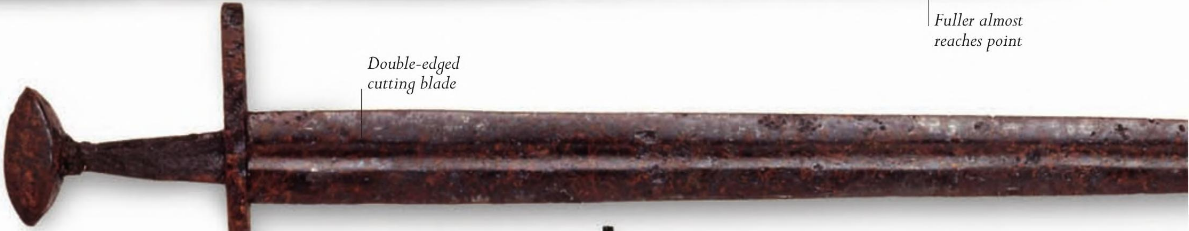
This heavy blade was typical of the swords used in the First and Second Crusades (1096–99 and 1147–49 respectively). It had a narrow edge, with wide quillons that curved towards the blade.

▼ FIRST CRUSADE SWORD

Date c.1100
Origin Northern Europe
Length 99.5cm (39in)

The massive double-edged blade of this early 12th-century sword is typical of the weapons that would have been carried by knights on the First Crusade (1096–99).

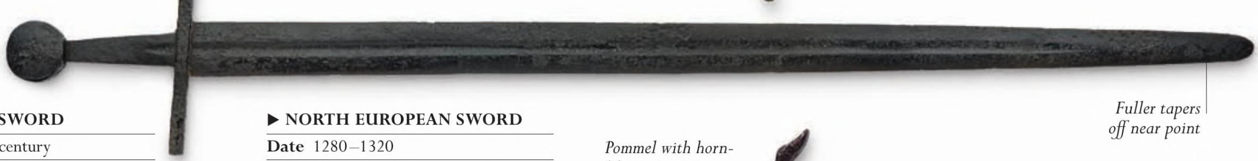

Straight, slightly tapering quillons
Oval, conical pommel
Fuller almost reaches point


Double-edged cutting blade

▶ DOUBLE-EDGED SWORD

Date 1150–1200
Origin Northern Europe
Weight 1.95kg (4¼lb)
Length 82.2cm (32¼in)

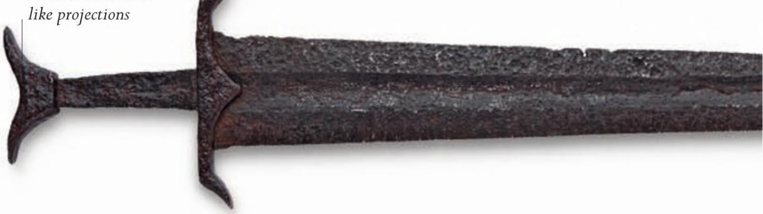
The blade of this heavy cutting sword was long and had two cutting edges. Its simple cross-guard, short hilt, and brazil-nut-shaped pommel are characteristic of 12th-century swords.


Wide, narrow cross
Fuller tapers off near point

▲ EUROPEAN SWORD

Date Early 13th century
Origin Europe
Weight 1.2kg (2½lb)
Length 1m (3¼ft)

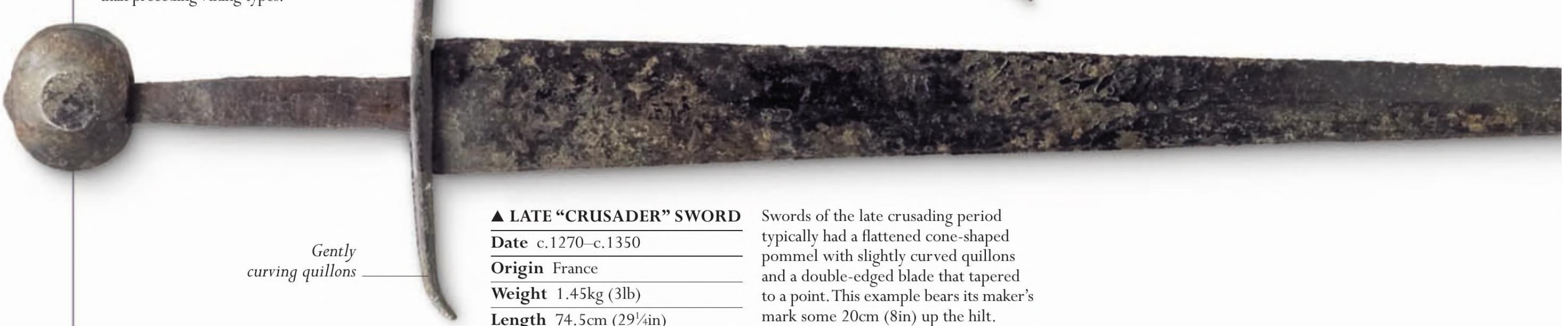
Common between the 10th and 14th centuries, swords known as "Type X" generally had wide blades with a brazil-nut-shaped pommel. They also had a narrower and longer cross-guard than preceding Viking types.


Pommel with horn-like projections

▶ NORTH EUROPEAN SWORD

Date 1280–1320
Origin Northern Europe
Weight 1.2kg (2½lb)
Length 91.4cm (36in)

Plate armour became increasingly common during the 13th century. As a consequence, swords with stiffer, pointed blades, better adapted to thrusting and exposing gaps in plate armour, were developed.


Gently curving quillons

▲ LATE "CRUSADER" SWORD

Date c.1270–c.1350
Origin France
Weight 1.45kg (3lb)
Length 74.5cm (29¼in)

Swords of the late crusading period typically had a flattened cone-shaped pommel with slightly curved quillons and a double-edged blade that tapered to a point. This example bears its maker's mark some 20cm (8in) up the hilt.

Sharply tapered blade

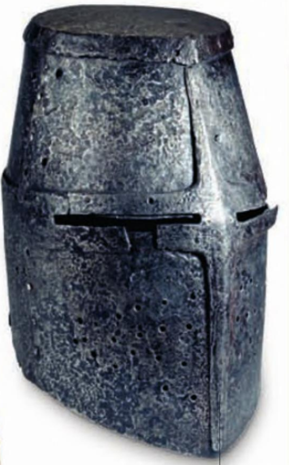
▶ **GREAT HELM**

Date 1250–1300

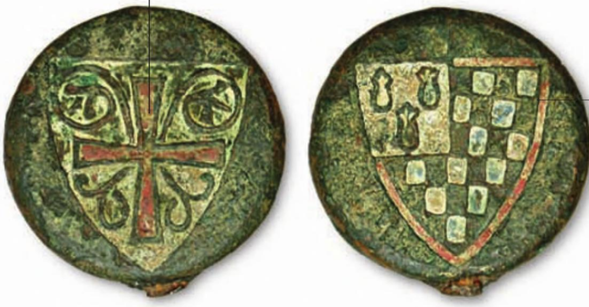
Origin Northern Europe

Material Iron

In use from the time of the Third Crusade (1189–92) for about a century, the cylindrical *heaume* or great helm completely enclosed the wearer's face, so became stifling in battle. Narrow visor slits allowed limited vision.



Cross-shaped plate on front



Red cross crusader badge

The Dreux family arms

▲ **SWORD POMMEL**

Date 1250

Origin France or England

Material Iron, enamel

Enamelled with the Dreux family arms, this pommel probably came from the sword of Peter de Dreux, Duke of Brittany. He fought alongside Louis IX of France at the disastrous Battle of Mansourah in 1250, during the Seventh Crusade.

Flattened diamond-shaped blade in cross-section

▲ **"CRUSADER" SWORD**

Date 12th century

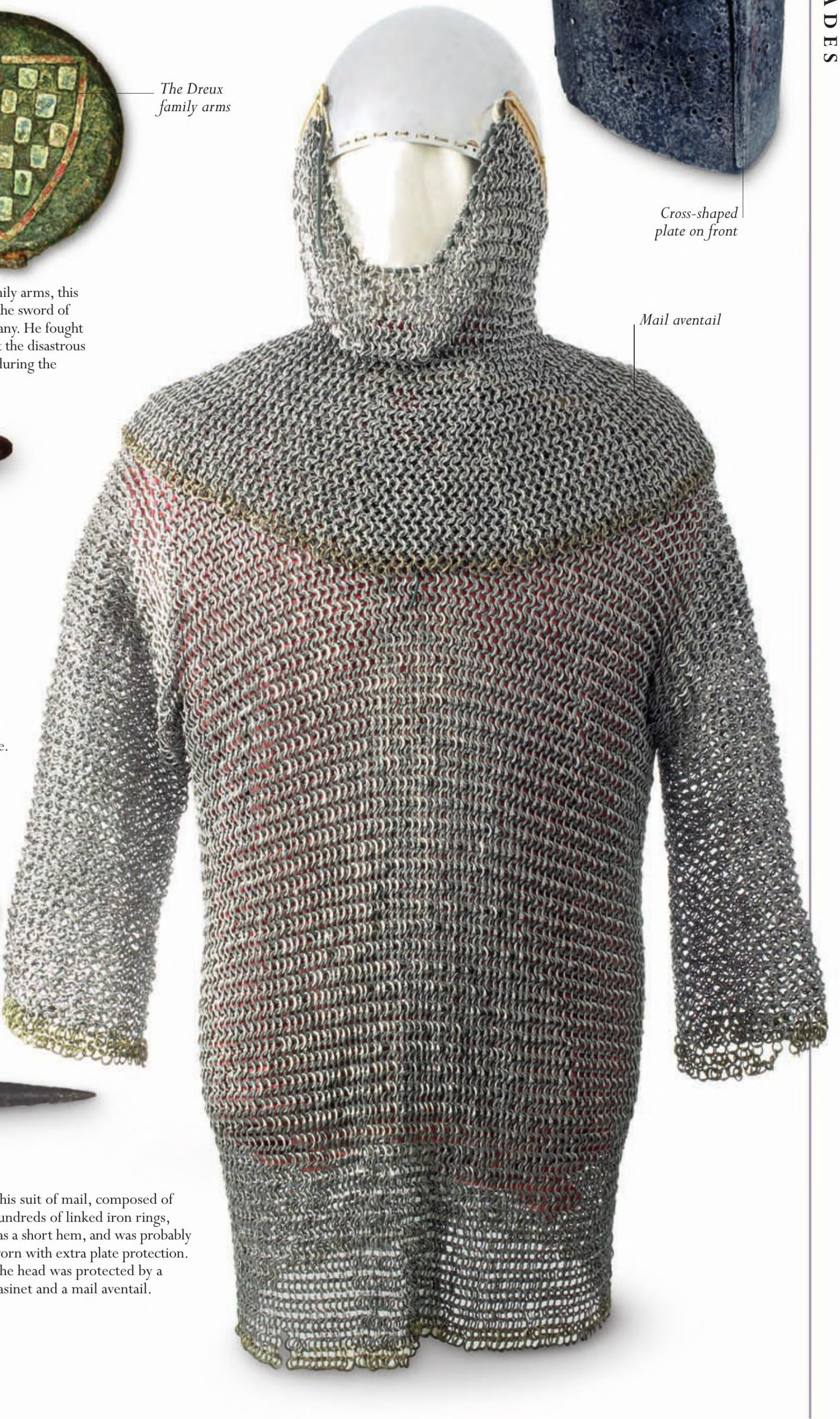
Origin Western Europe

Weight 1.27kg (2¾lb)

Length 96.5cm (38in)

Swords with broad blades and simple cross-guards and pommels became popular during the Crusades, and were used widely throughout Europe.

Flattened diamond-section blade



Mail aventail

▶ **MAIL ARMOUR**

Date 1339–65

Origin Austria

Material Iron

This suit of mail, composed of hundreds of linked iron rings, has a short hem, and was probably worn with extra plate protection. The head was protected by a basinet and a mail aventail.

KEY DEVELOPMENT

EAST ASIAN WARFARE

Three distinct approaches to weapons and warfare evolved in medieval East Asia. While steppe tribesmen depended upon horses and the compound bow, and China combined advanced technology with mass peasant armies, the Japanese, developed the idiosyncratic, highly ritualized fighting style of the samurai warrior.

Under the dynasties of the Tang (618–907CE) and the Song (960–1279), China was the world leader in technological innovation. However, defending its long frontier from bow-armed nomadic horsemen often overwhelmed the country's military resources.

The Song fielded large armies of conscripted foot soldiers. Although most were equipped with basic staff weapons, such as the halberd, they also used an impressive array of crossbows, ranging from simple, hand-held bows to large, lever-operated repeating crossbows capable of emptying a 10-bolt magazine in under 20 seconds. By the 13th century, the Song armies also had primitive gunpowder weapons, although these had only a marginal impact.

INVADING FORCES

Despite its technological and numerical advantages, China was often invaded by steppe peoples. In the 12th century, the Song lost control of northern China to federations of steppe tribes – first the Jurchen, and then the Mongols. The vulnerability of China was partly due to its military failings – primarily the lack of cavalry – but it also reflected the remarkable effectiveness of the steppe warriors. When a leader united them in sufficiently large numbers, the steppe tribes' ability to campaign over long distances and their deadly efficiency in battle enabled them to achieve wide-ranging conquests; they campaigned as far west as Hungary and Poland. Between the 1380s and 1405, Timur – who claimed descent from Genghis Khan – campaigned victoriously from Delhi, in India, to Ankara, in Turkey. The Song dynasty retained control of southern China by exploiting its naval strength on the Yangtze River, which formed a barrier against the north. The permanent Song navy, founded in 1132, deployed a remarkable variety of vessels, including multi-deck "tower ships" that were armed with various kinds of catapult. Some warships were propelled by human-powered paddle wheels; others were fast-moving, oared galleys. The Song could not hold out against the Mongol forces of Kublai Khan, however, who created his own fleet to conquer southern China in 1279, and later sailed to Japan and Java, a tradition continued by the next native Chinese dynasty, the Ming (1368–1644). From 1405 to 1433, the eunuch admiral Zheng He led the Ming fleet to East Africa. But he soon turned his attention to defending the steppe frontier, diverting resources to build the Great Wall.

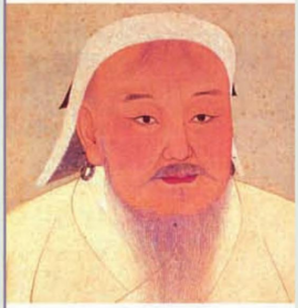
Meanwhile, a distinctive military culture had developed in Japan. Samurai warriors emerged in the 10th century as soldiers in the service of the Japanese emperors, and over time they formed

KEY **FIGURE**

GHENGHIS KHAN

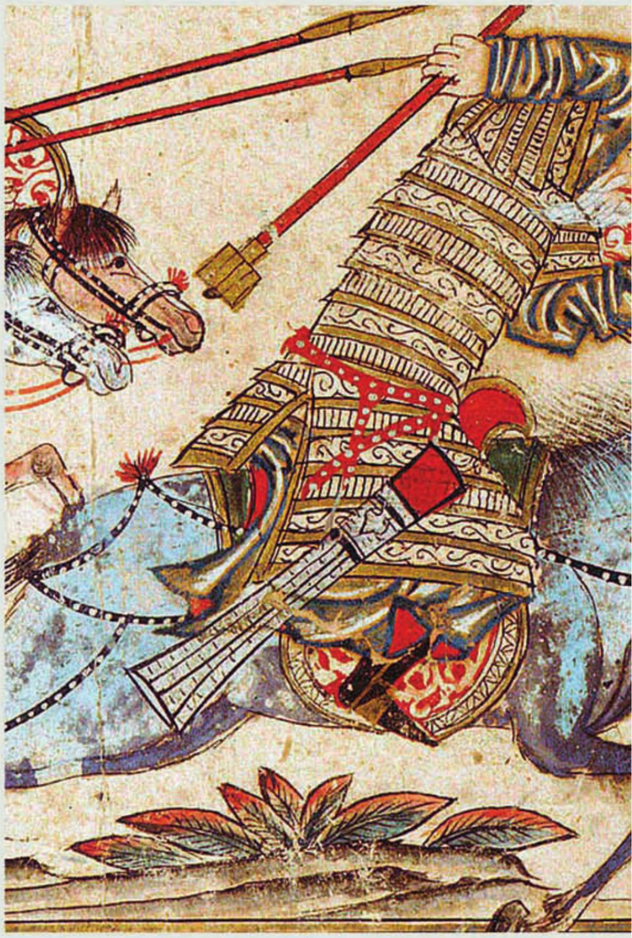
1162–1227

Originally named Temujin, the founder of the Mongol Empire took the title Genghis Khan after uniting the steppe tribes in 1206. By the time of his death, his horsemen had campaigned as far west as the Black Sea coast and begun the conquest of China.



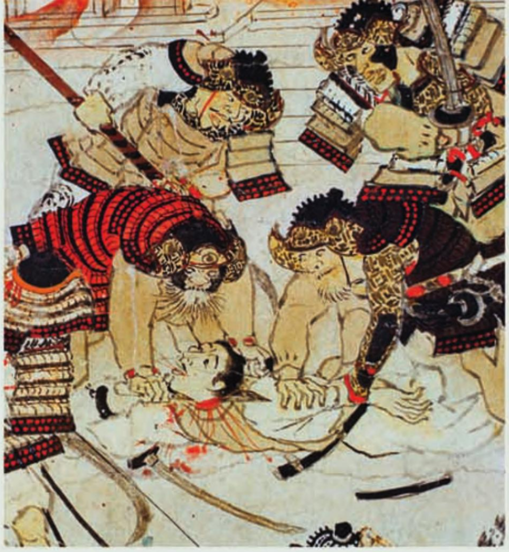
▲ Genghis Khan inspired the steppe horsemen with his ambition to create a universal empire.

▼ TIMUR
A Turco-Mongol warrior from Uzbekistan, Timur defeated the Mongol Golden Horde, the Egyptian Mamluks, and the Ottoman Turks. Before he died in 1405, he was planning an invasion of China.



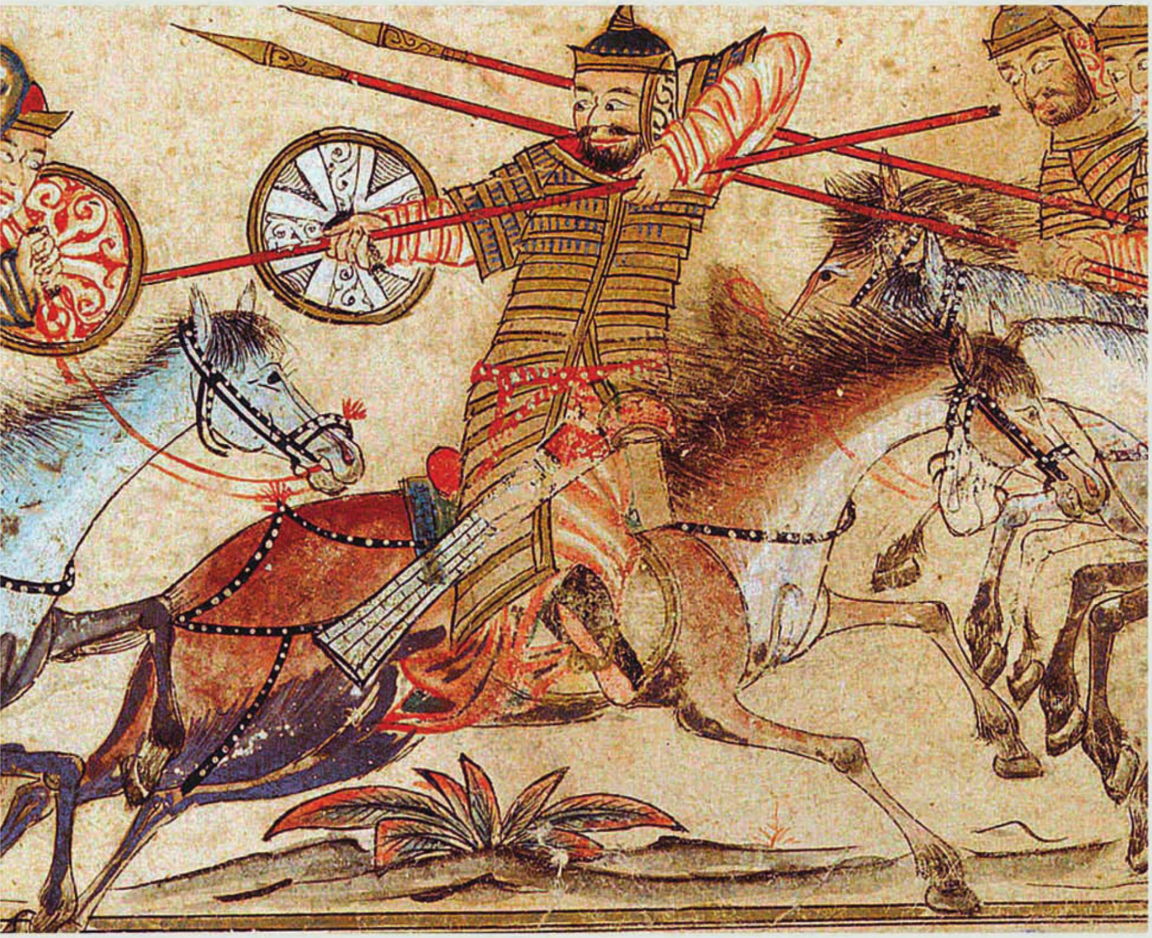
warrior-clans with regional power bases. In the 12th-century Gempei Wars, the Minamoto and Taira clans fought, the Minamoto emerging as military rulers of Japan – the shoguns.

In this period, the samurai were primarily mounted bowmen; the art of Japanese sword-making only evolved in the late middle ages. Samurai warfare was highly stylized: battles opened with archery duels between notable warriors, and defeat led to ritual suicide (*hara-kiri*). Nevertheless, when Kublai Khan tried to invade Japan by sea, in 1274 and 1281, he found them to be formidable foes: the Mongols were repulsed, albeit with help from the bad weather that wrecked the invasion fleets.



◂ **A SAMURAI RITUAL BEHEADING**
It was the custom in medieval Japan for a samurai killed in combat to be beheaded by his enemies. The severed head was then returned to his relatives, mounted on a spiked board.

> "They come with the **swiftness of lightning**, ravaging and slaughtering, **striking everyone with terror** and with incomparable horror"
>
> **ENGLISH MONK MATTHEW PARIS**, DESCRIBING THE MONGOLS, c.1250



◂ **THE BATTLE OF AIN JALUT**
One of the very few defeats suffered by the Mongols came at Ain Jalut, in Palestine, in 1260. The steppe horsemen were beaten by the army of Mamluk Egypt, which fought in a not dissimilar style.

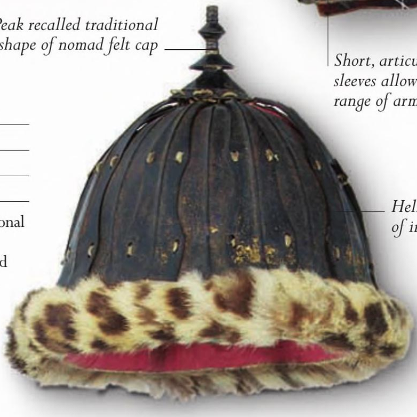
KEY **EVENTS**

10TH–15TH CENTURY

- **10th century** The samurai are first mentioned, as the Japanese emperor's guards.
- **11th century** In China, gunpowder is first used in warfare.
- **1132** The Song rulers of southern China establish a permanent navy.
- **1180–85** The Gempei Wars between samurai clans lead to the establishment of the Minamoto shogunate in Japan.
- **1241** At the battles of Liegnitz, in Poland, and Mohi, in Hungary, Mongol horsemen prove their military superiority to forces of European knights.
- **1385–1405** Timur carries out campaigns of conquest across much of Asia.
- **1474** Ming China begins the reconstruction of the Great Wall as a barrier against steppe horsemen.

MONGOL ARMOUR AND WEAPONS

The Mongol warriors who swept through Central Asia, Eastern Europe, and China in the 13th century came from a nomadic tradition that valued mobility and the ability to strike from a distance. Mongol discipline was fierce – the army punished unlicensed plundering with death. They were organized into *tümens* (units of 10,000 men) centred around an imperial guard. Fighting from horseback, the Mongols were armed with composite bows that had a range of up to 200m (655ft), and a mixture of light arrows for greater range and heavier ones for penetrative power. Once an enemy had been softened up by multiple volleys of arrows, heavier cavalry armed with sabres moved in to finish off the survivors.



Peak recalled traditional shape of nomad felt cap

Helmet bowl of iron plates

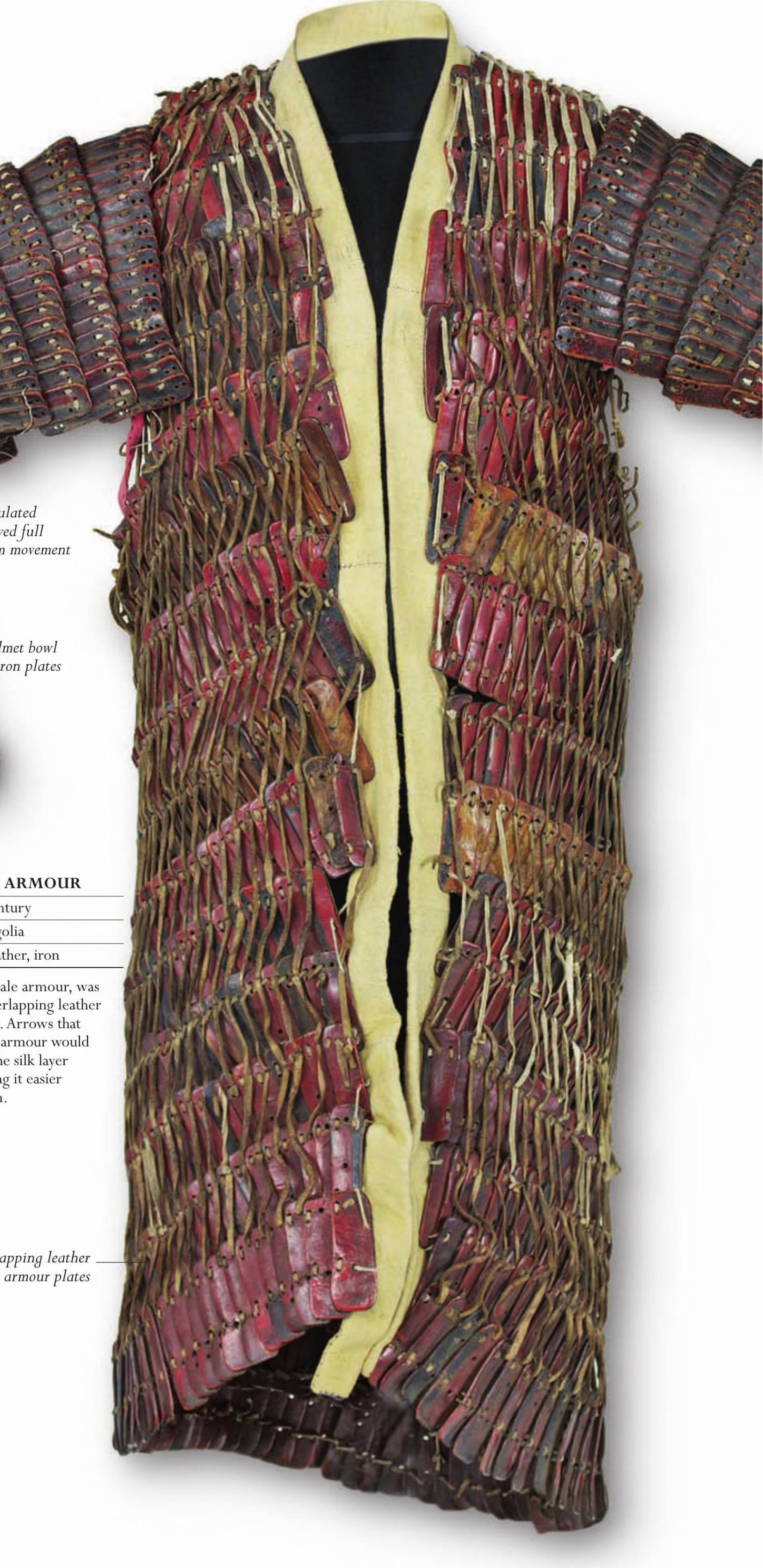
▶ MONGOL HELMET

Date 13th century

Origin Mongolia

Material Iron, leather, fur

The warrior's helmet had a traditional conical shape, trimmed with a padded roll of fur for a snug fit and protection against extreme cold.



Short, articulated sleeves allowed full range of arm movement

Overlapping leather armour plates

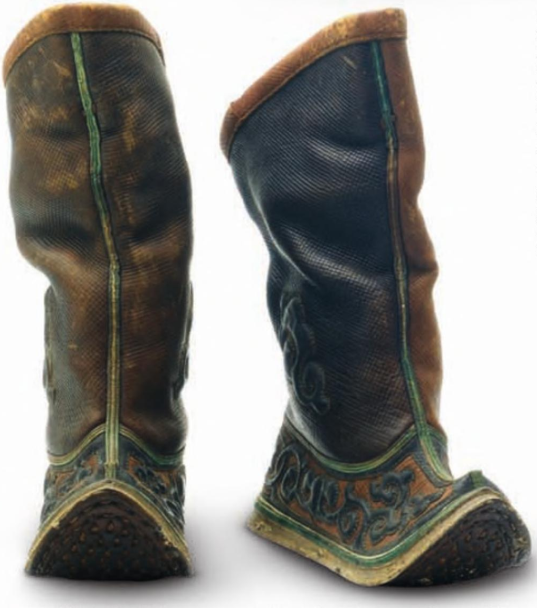
▶ MONGOL ARMOUR

Date 13th century

Origin Mongolia

Material Leather, iron

Lamellar, or scale armour, was made from overlapping leather or metal strips. Arrows that penetrated the armour would get caught in the silk layer beneath, making it easier to extract them.



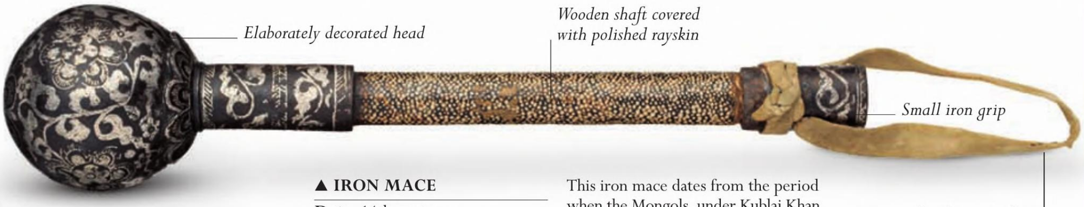
▲ MONGOL BOOTS

Date 18th century

Origin Mongolia

Material Leather, felt

A Mongol warrior generally wore felt boots in both summer and winter. The boots provided protection from the bitter cold of the steppes and prevented their legs from rubbing against the horse's back and chafing.


Elaborately decorated head
Wooden shaft covered with polished rayskin
Small iron grip
Leather wrist loop

▲ IRON MACE

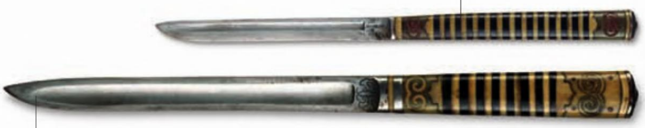
Date 14th century

Origin China or Mongolia

Weight 1.17kg (2½lb)

Length 40cm (15¾in)

This iron mace dates from the period when the Mongols, under Kublai Khan, overthrew the native ruling dynasty of China and took power. The intricate decoration suggests that it belonged to a warrior of high status.

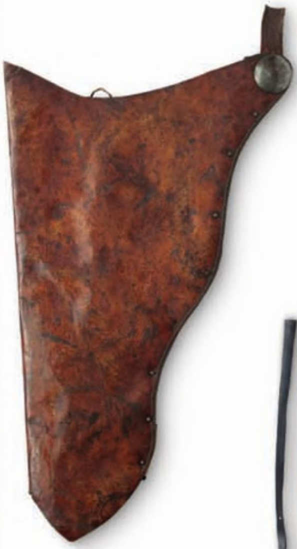

Ivory-inlaid handle
Silver blade with deep fuller

▲ MONGOL DAGGERS

Date 14th century

Origin Mongolia

Various types of short swords and daggers were used by Mongol warriors for close-quarter combat. These are modern replicas in the style of the 14th century.



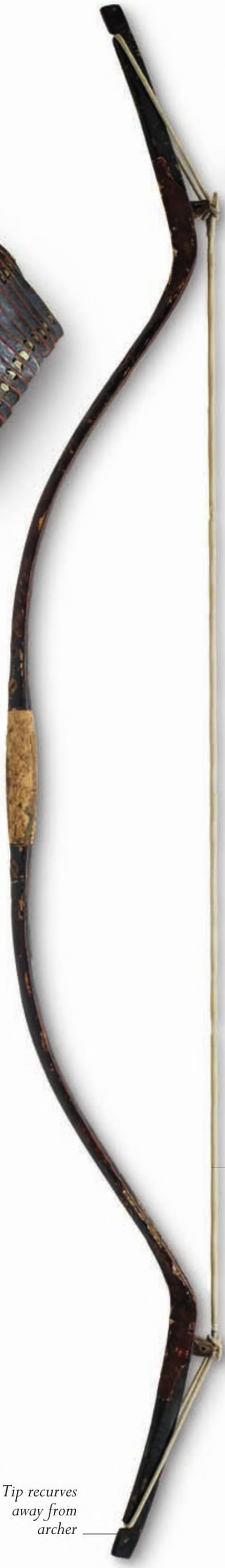
▲ BOW CASE

Date 15th century

Origin Mongolia

Material Leather

Mongol warriors protected their precious composite bows by carrying them in leather cases, which were slung on their left side while riding. They were designed to give the warrior easy access to his bow while on horseback.


Animal hide string
Tip recurves away from archer

◀ BOW IN MONGOL STYLE

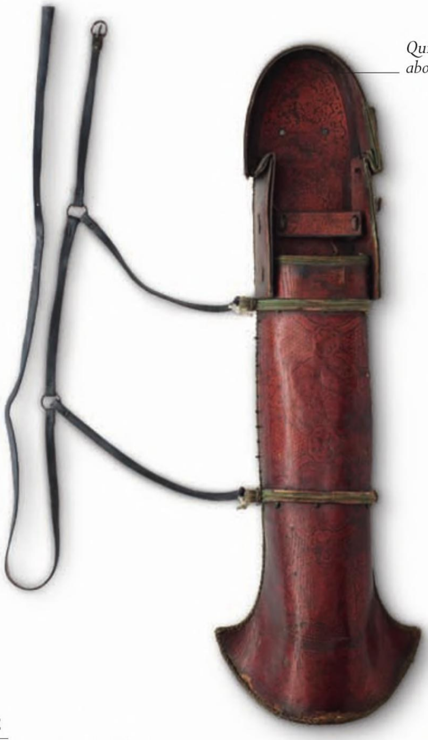
Date 18th century

Origin China

Weight 1.07kg (2½lb)

Length 79.4cm (31¼in)

The composite bows used by the Mongols were made up of laminated layers of wood, horn, and sinew, which gave them greater elasticity and thus a longer range than a simple wooden bow. These bows had maximum strength for minimum length, a valuable attribute on horseback.


Quiver carried about 60 arrows

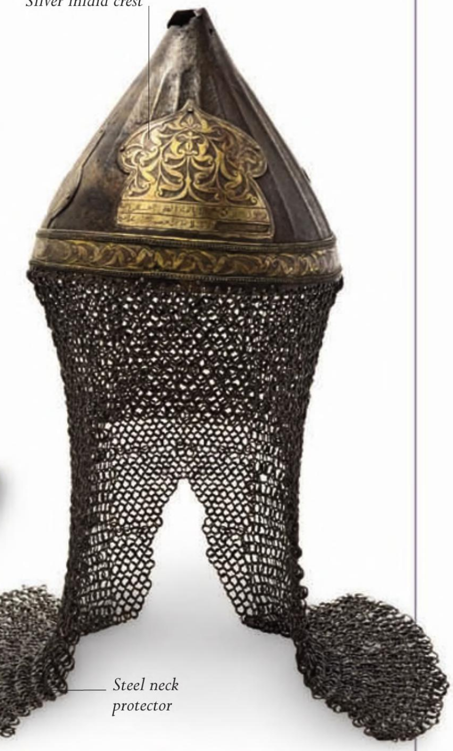
▲ QUIVER

Date 15th century

Origin Mongolia

Material Leather

A Mongol quiver was divided into a number of sections, allowing the warrior to quickly select different arrows for different purposes – heavy ones for piercing armour, or light ones for long-range firing. Arrows with scissor-shaped heads were designed to make deep flesh wounds in the bow arms of their enemies.


Silver inlaid crest
Steel neck protector

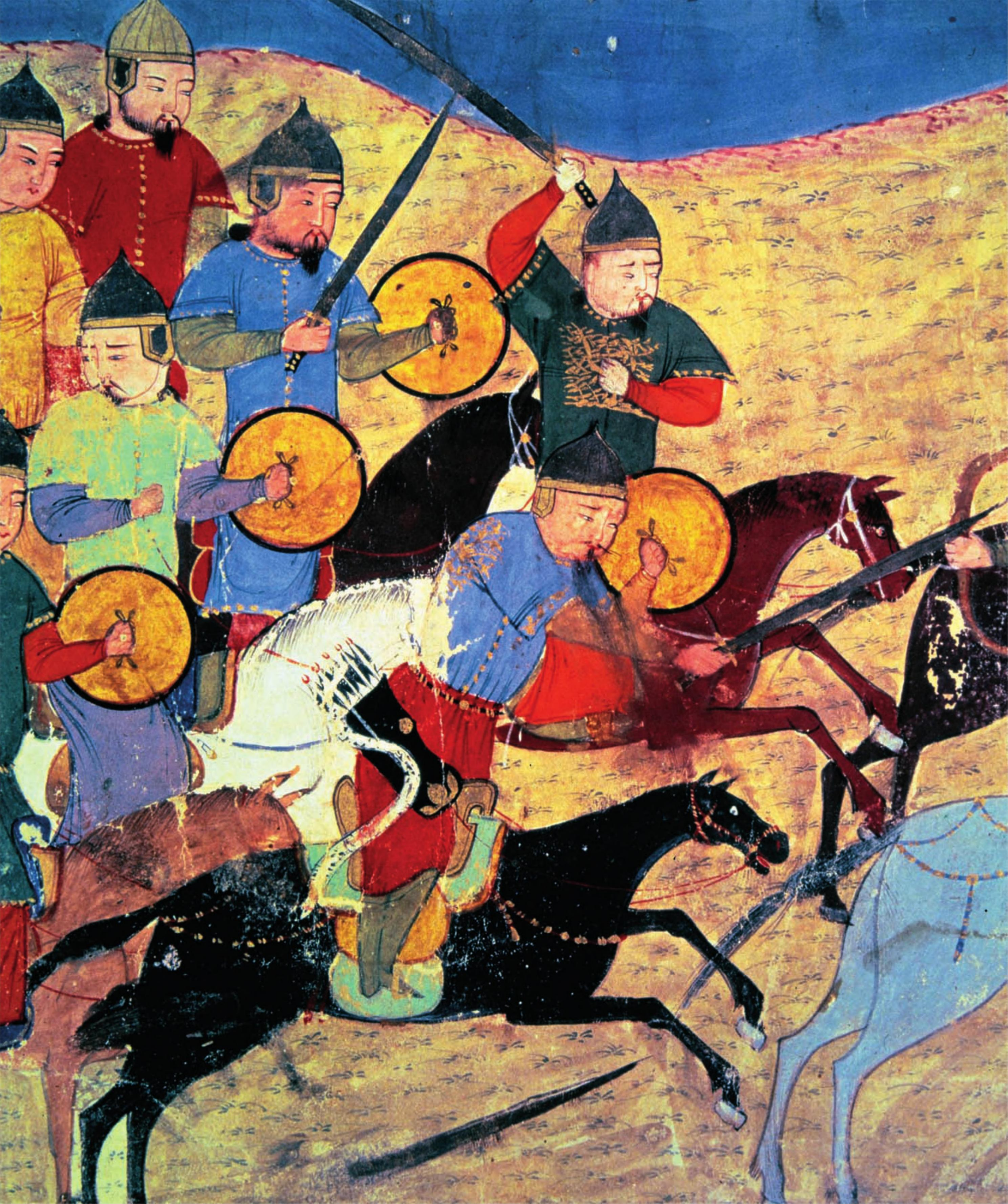
▲ NOGAI HELMET

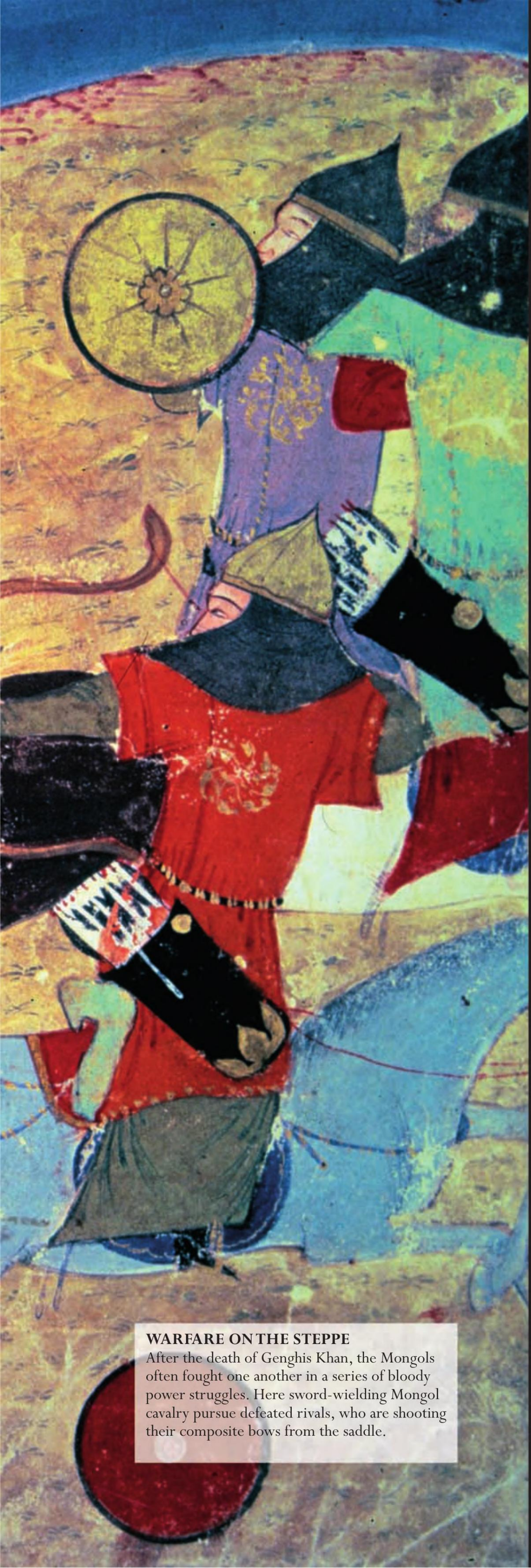
Date Late 16th century

Origin Russia

Material Steel, iron, silver

This late Mongol helmet of the Nogai people (descendants of Genghis Khan) retains the conical shape of earlier types, but the neck guard is made of mail rather than leather.





WARFARE ON THE STEPPE
After the death of Genghis Khan, the Mongols often fought one another in a series of bloody power struggles. Here sword-wielding Mongol cavalry pursue defeated rivals, who are shooting their composite bows from the saddle.

STEPPE HORSEMEN

THE MONGOLS AT WAR

Under the leadership of Genghis Khan from the early 13th century, the Mongols created the largest empire in history. Their secret was the ability to blend the traditional fighting tactics of nomadic horsemen with technology adopted from the settled civilizations that they subjugated.

Born Temüjin, the son of a tribal chief, the future Genghis Khan spent two decades uniting the various Mongol and Turkic peoples of eastern Central Asia. Although they had similar lifestyles – living in tents and in close proximity to their horses – the Mongols, Merkits, Naimans, Keraits, Tatars, and Uighurs were traditionally hostile to one another. However, using a combination of savage warfare and cunning diplomacy, Temüjin united them into a vast steppe confederation. In 1206, the tribes formally acknowledged his authority and he assumed the title Genghis Khan, or "lord of all". With a huge army at his disposal, Genghis embarked on campaigns that reached from Beijing (Zhongdu) in China, to the wealthy Central Asian cities of Samarkand and Bukhara (in modern-day Uzbekistan), before his death in 1227.

The Mongols' style of warfare originated from hunting. With their powerful composite bows and sturdy, nimble horses, large groups of riders would pursue herds across the steppe, then encircle and kill the animals with arrows; this is also how they attacked their enemy in battle. The Mongols had none of the obsession with personal bravery and honour that governed medieval European knights at the time. A traditional steppe horseman would use his bow to kill from a distance whenever possible, instead of risking his life in a close-quarters encounter. Similarly, Mongol commanders directed battles from a position of safety, using flags, smoke signals, and trumpets to convey orders; they considered it foolish to risk personally leading their men into combat. However, they also learned to augment their traditional mounted bowmen with armoured cavalry equipped with swords and lances, and protected by metal armour, instead of their usual felt or silk tunics. Rather than avoiding close combat, this heavy cavalry would charge an enemy already weakened by the bowmen, and deliver the final, crushing blow.

Overall, their approach to warfare was ruthlessly practical: they would lure the enemy into a position of weakness, then destroy them. Speed of manoeuvre was therefore of the essence. Travelling light and living off the land, they could overcome the more cumbersome armies of settled civilizations.

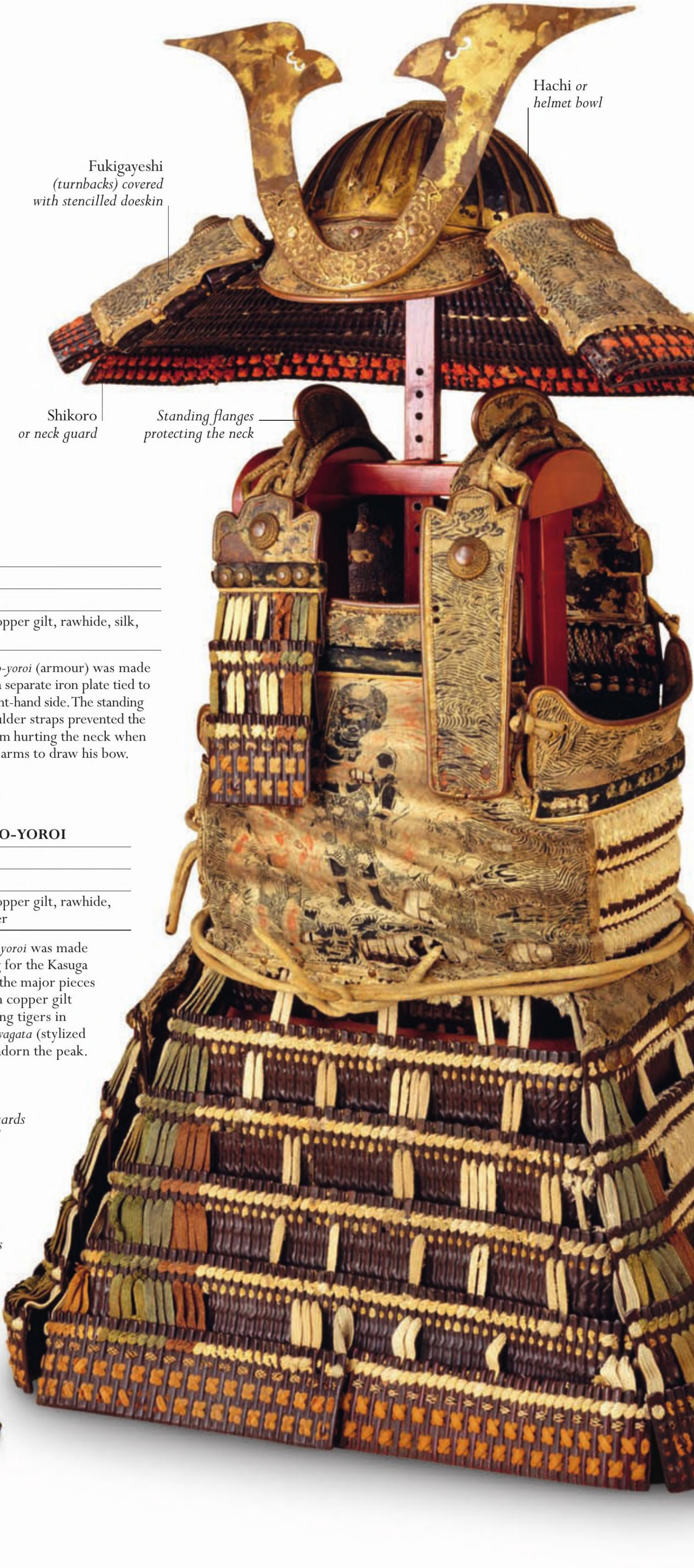
THE OLD AND THE NEW

However, if traditional steppe warfare was the foundation for Genghis Khan's empire, then its expansion was strongly based on new technology adopted from conquered territories in China and the Muslim world. From Beijing in 1214–15 to Baghdad in 1258, the Mongols demonstrated their skill at siege warfare, battering city walls with projectiles hurled by mangonels and trebuchets. They were also pioneers in the use of gunpowder as a military explosive and incendiary material, using primitive bombs hurled by catapult, and hand-held devices that were ancestors of the flamethrower and the handgun.

At their peak the Mongols were a near-unstoppable military force, but their high-casualty tactics prevented the long-term consolidation of their far-flung realms. By the end of the 14th century, the mighty empire that Genghis had so skilfully founded was reduced to fragments.

EAST ASIAN WEAPONS AND ARMOUR

Lamellar (scaled) armour – made from small rectangular iron, leather, or bronze plates laced together – originated in the classical world, but was perfected by the Japanese: from the 11th century onwards, nobility wore the *o-yoroi* (armour), specifically designed for mounted archers. By the 14th century, the design of Japanese swords reached its peak; a superior *tachi* or curved blade, worthy of an expensive mount (hilt and scabbard), was a symbol of high status, and samurai wore their swords not only on the battlefield but also when in civilian dress. In China, lamellar armour was replaced by armour made from plates riveted to a fabric backing, similar to the European brigandine. Following the Mongol invasion of China in the 13th century, curved swords influenced by the steppe sabre became more widely used alongside the classic straight-edged *jian*, and by the middle of the Ming dynasty (1368–1644), many swords had also been imported from Japan into China. It was during this period that Chinese gunpowder weapons were first used in battle.


Hachi *or helmet bowl*
Fukigayeshi *(turnbacks) covered with stencilled doeskin*
Shikoro *or neck guard*
Standing flanges protecting the neck

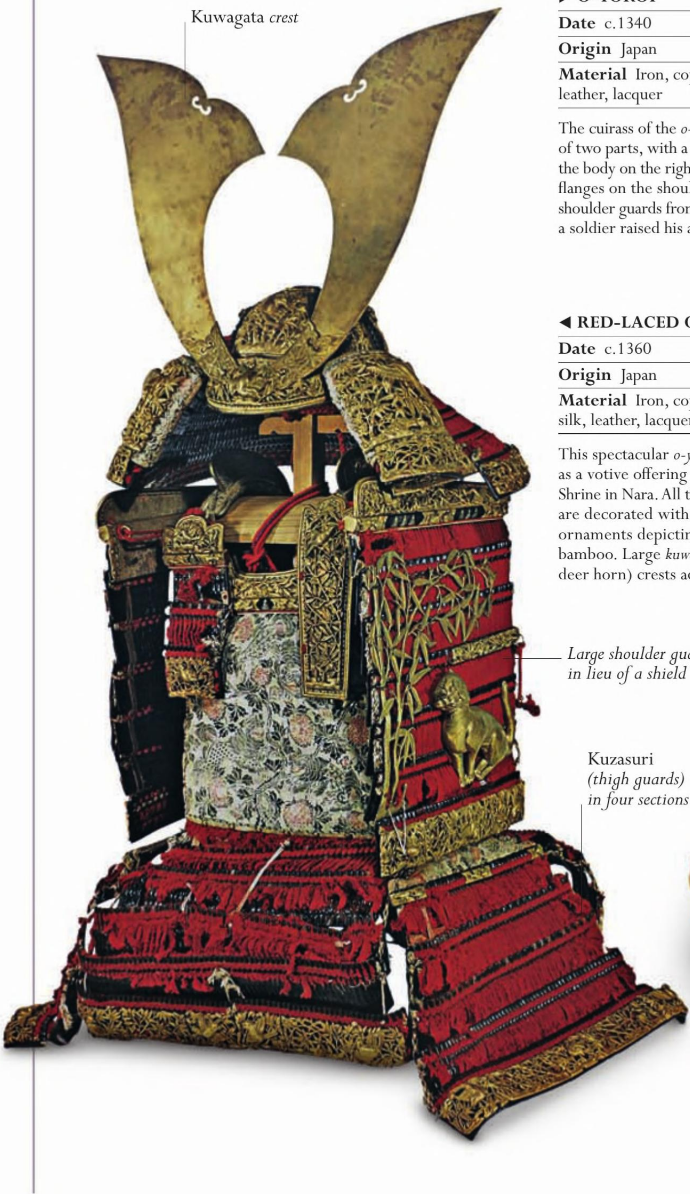
▶ **O-YOROI**

Date c.1340

Origin Japan

Material Iron, copper gilt, rawhide, silk, leather, lacquer

The cuirass of the *o-yoroi* (armour) was made of two parts, with a separate iron plate tied to the body on the right-hand side. The standing flanges on the shoulder straps prevented the shoulder guards from hurting the neck when a soldier raised his arms to draw his bow.


Kuwagata *crest*
Large shoulder guards in lieu of a shield
Kuzasuri *(thigh guards) in four sections*

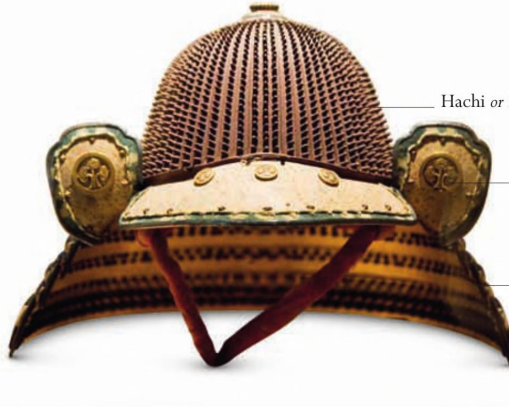
◀ **RED-LACED O-YOROI**

Date c.1360

Origin Japan

Material Iron, copper gilt, rawhide, silk, leather, lacquer

This spectacular *o-yoroi* was made as a votive offering for the Kasuga Shrine in Nara. All the major pieces are decorated with copper gilt ornaments depicting tigers in bamboo. Large *kuwagata* (stylized deer horn) crests adorn the peak.


Hachi *or helmet bowl*
Honda family crest
Shikoro *or neck guard*

▶ KOBOSHI KABUTO

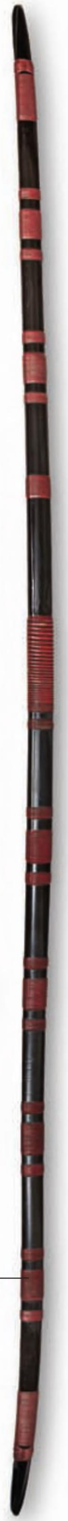
Date	15th–16th century
Origin	Japan
Material	Iron, copper gilt, leather, silk, lacquer

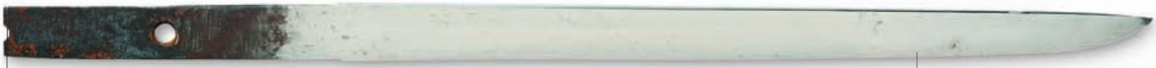
High-sided, multi-studded helmets in the style known as *koboshi kabuto* could contain as many as 2,000 rivets. It was quite common for a good helmet bowl to be recycled: this one was refurbished with a new neck guard, visor, and crest ornaments, for a member of the Honda family.

▶ YUMI

Date	19th century
Origin	Japan
Weight	220g (7¾oz)
Length	1.36m (4½ft)

The design of the *yumi* (Japanese bow) has been unchanged since at least 1000CE. It was built with bamboo glued to the back and front. The grip was positioned near the lower end to allow the bow to be used on horseback.

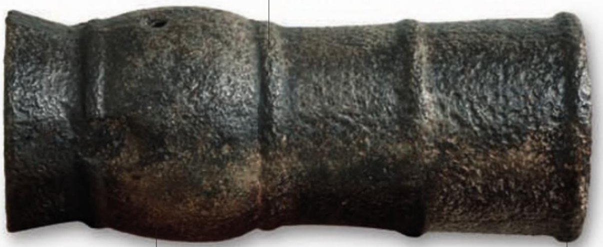

Rattan binding to prevent joints weakening from damp


Shortening shown by original hole for grip at end of tang
Flat-sided blade without a ridge

▲ TANTO BLADE

Date	1400
Origin	Japan
Weight	145g (5oz)
Length	21.8cm (8½in)

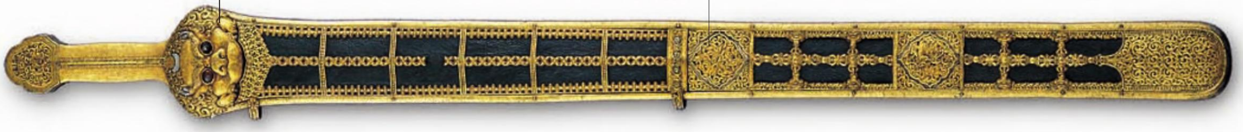
Daggers were thrust through a sash on the left-hand side when wearing armour. The *tanto* (dagger) blade was acutely pointed and sturdy, designed to pierce armour when opponents were engaged in hand-to-hand combat.


Reinforce ring
Swollen breech region
Muzzle

▶ IRON CANNON

Date	c.1400
Origin	China
Length	47cm (18½in)
Bore	10cm

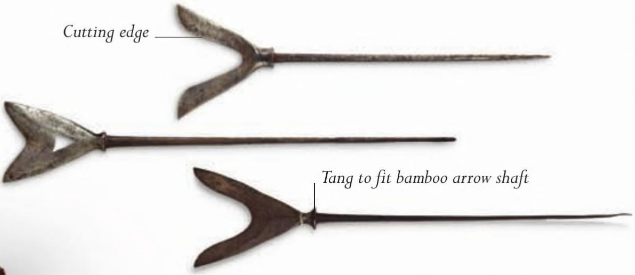
This small cannon was fired from a trestle-like stand. It was cast with a bulbous breech region to resist pressure. Rather than firing a single projectile, it was loaded with a number of smaller missiles.


Monster motif on hand guard
Wooden scabbard bound in gilt iron

▲ JIAN

Date	Early 15th century
Origin	China
Weight	1.3kg (2¾lb)
Length	90.3cm (35½in)

The *jian* (Chinese straight sword) was the favoured weapon of figures in both Taoist and Buddhist mythology. This sword, with a richly decorated hilt and scabbard, was made for presentation to a Tibetan monastery.


Cutting edge
Tang to fit bamboo arrow shaft

▲ YA NO NE

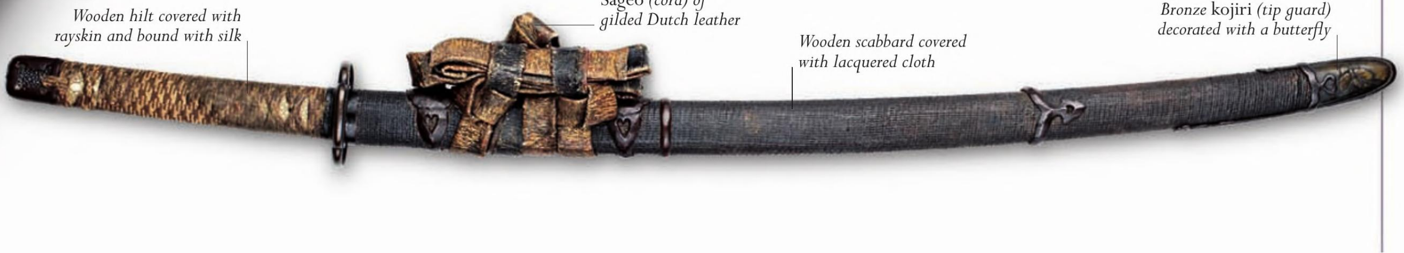
Date	18th century
Origin	Japan
Weight	20–40g (¾–1½oz)
Length	18–24cm (7–9½in)

Japanese archers used many shapes of *ya no ne* (arrowheads). These examples are forked heads called *karimata* because of their resemblance to a skein of geese. They have a long tang to fit into the bamboo shaft.

▼ TACHI

Date	18th century
Origin	Japan
Weight	130g (4½oz)
Length	74.5cm (29¼in)

The *tachi* was a long sword worn slung from the belt, attached by the *sageo* (cord) on its scabbard. The *tachi* was superseded by the *katana* for civilian wear by samurai, but remained the proper weapon to be worn with armour.


Wooden hilt covered with rayskin and bound with silk
Sageo *(cord) of gilded Dutch leather*
Wooden scabbard covered with lacquered cloth
Bronze kojiri *(tip guard) decorated with a butterfly*

EPIC FORTIFICATION

THE GREAT WALL OF CHINA

The longest defensive fortification ever built, the Great Wall of China protected northern China from incursions by mounted warriors from the steppe. First constructed over 2,000 years ago and rebuilt in the 15th century, it was a piece of military infrastructure on an unprecedented scale.

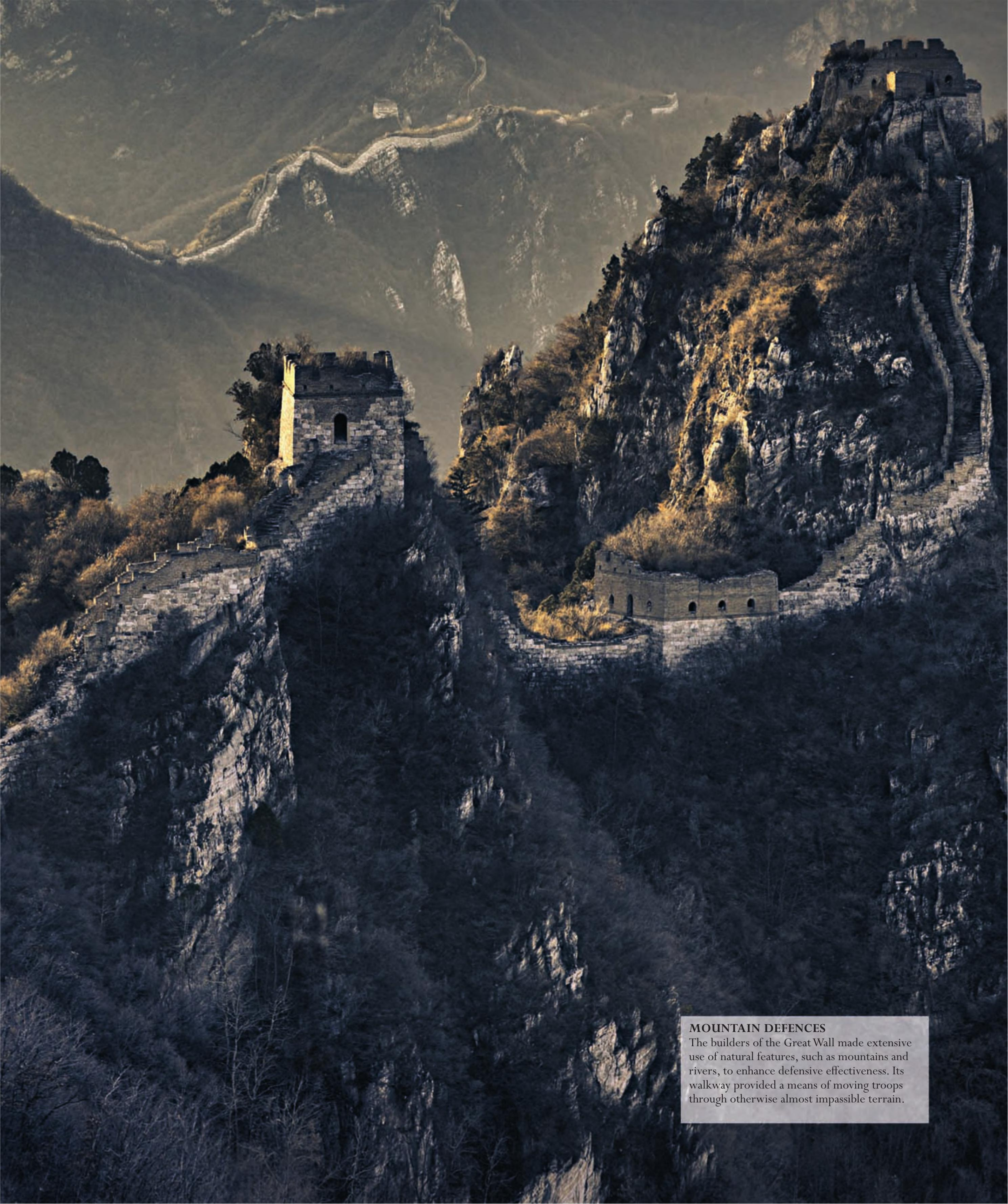
China's settled civilization was always vulnerable to the nomadic, bow-wielding horsemen living in the vast spaces of inner Asia to the north and west. The wealth of Chinese cities and agricultural lands had long attracted these highly mobile steppe raiders, from the Xiongnu and the Jurchen to the Mongols and the Manchu. Qin Shi Huang, known as the First Emperor because of his unification of China in 221 BCE, created the original Great Wall by joining up a number of existing fortifications, some already 500 years old. Built mostly of packed earth, with some wood and stone, over successive centuries the Qin Wall was only partially and sporadically maintained, leaving northern China exposed to pillage.

THE NEED FOR DEFENCES

The Ming dynasty came to power in the 14th century, and represented a reassertion of Chinese national pride after a period of rule by Mongol conquerors. At first, the Ming were expansionist in outlook, seeking to extend Chinese territory by sea into the Indian Ocean, and by land into Central Asia. But ambitions to subdue the steppe tribes came to a halt in 1449, when Emperor Zhengtong was defeated and captured by Oirat Mongols on the frontier at the Battle of Tumu. As well as this military disaster, the need for protection against the steppe horsemen had become more acute since 1421, when the northern city of Beijing was made the official Ming capital, instead of the more southerly city of Nanjing. Beijing was virtually a frontier town, and was critically exposed to attack. However, the steppe warriors' bows and blades, though deadly when used in a pitched battle, would be unsuited to assailing fortifications.

In 1474, work began on a new Great Wall made from brick and stone, strong enough to withstand attack by the horsemen. Built mostly along the line of the old Qin Wall, in many places the remains of the original earth structure were used as foundations. Vast resources of human labour were devoted to building 5,650km (3,510 miles) of fortification, much of it across difficult terrain. The function of this wall was partly symbolic – to mark the territory in which Chinese civilization held sway. But it was mainly a practical, utilitarian military structure. As a physical barrier, it was sufficiently solid to repel the parties of horsemen armed with composite bows and bladed weapons. Sturdy fortresses were sited along its length, protecting key towns, mountain passes, or river crossings. More than 7,000 lookout towers enabled small garrisons of soldiers armed with pikes, swords, and crossbows to keep watch for intruders, and signal for reinforcements in case of attack. The walkway along the top of the wall allowed for the rapid movement of infantry from barracks or forts to any point that was under threat.

The wall outlasted the Ming dynasty, which disintegrated in the 17th century. The invading Manchu horsemen were only able to conquer China because Chinese General Wu Sangui, guarding the Great Wall at the Shanhai Pass, deliberately opened its gates to allow them through to Beijing. The wall itself remained an effective feat of military engineering.



MOUNTAIN DEFENCES
The builders of the Great Wall made extensive use of natural features, such as mountains and rivers, to enhance defensive effectiveness. Its walkway provided a means of moving troops through otherwise almost impassible terrain.

KEY DEVELOPMENT

WARRIORS OF PRE-COLUMBIAN AMERICA

The first substantial records of war in Mesoamerica relate to the Maya, who ruled parts of Mexico, Guatemala, and Honduras from around 250CE until the 16th century, when the Spanish conquistadors arrived, ushering in the end of an era.

From 250–900CE, the Mayan lowlands were divided between city-states such as Tikal, Copan, and Yaxchilan, which were in a state of constant war with each other. Mayan warriors fought with spears and sometimes with wooden clubs that were inset with stone or obsidian blades. Records indicate that armour and shields were rarely used by Mayan warriors: their equipment appears to have been more suitable for sporadic raids than large-scale battles. Mayan armies were small and aristocratic, and Tikal's army, the largest, would have numbered no more than 1,000 warriors.

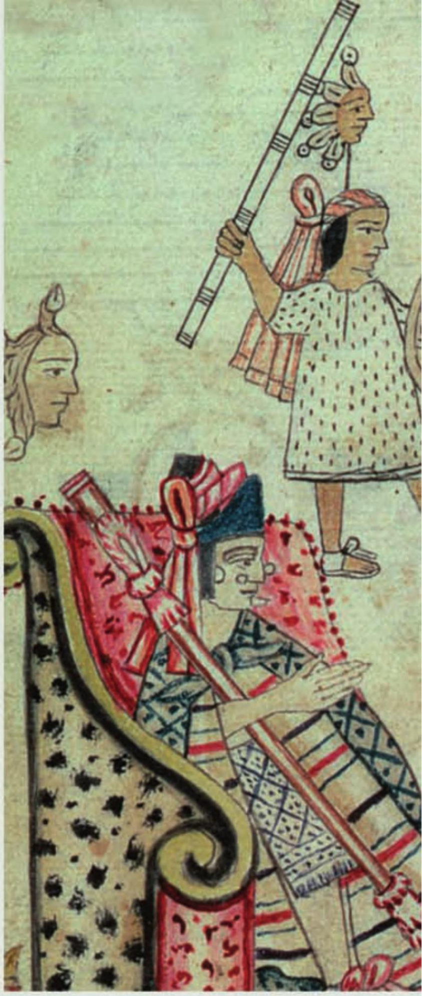
AZTEC TRADITIONS

The Aztecs (Mexica) originated from the Valley of Mexico and eventually settled at their future capital, Tenochtitlán, in 1325, but emerged as an imperial power only in the mid-15th century. They built up a system based on tribute, which ennobled successful warriors and created a society that valued military training, encouraging commoners to join the Aztec army. With a core of trained veterans and a ready supply of fresh warriors, the Aztecs were able to field armies of over 8,000 men and could overwhelm their opponents by sheer force of numbers. In battle, they relied on a barrage of arrows and slingstones, followed by an advance of close-order fighters armed with axes, maces, and clubs. Warriors wore body armour of cotton or leather, and elite soldiers covered these with the skins of fierce animals, such as jaguars.

THE INCA EMPIRE

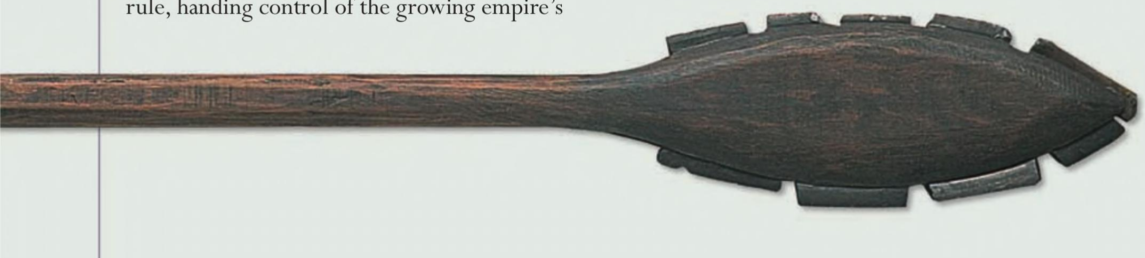
From 1438, under Pachacutí, the Inca, who had controlled a small state in the Cuzco area of Peru, took over the whole of the central Andes, absorbing other civilizations, such as the Chimú of northern Peru. As well as looting the capital, Chanchan, of its gold and precious stones, the Inca borrowed aspects of Chimú organization to consolidate their rule, handing control of the growing empire's provinces to a hereditary nobility. A series of well-built roads linked all parts of the empire, and a network of relay stations made it possible to send messages, enabling efficient central control of the provinces. To help rule a vast area that stretched from Ecuador to northern Chile, the Inca built hilltop fortresses and fortified outposts in the border regions of the empire, such as southern Bolivia.

Inca armies' success on the battlefield was not reliant on superior weaponry, but instead on numerical advantage and better use of tactics. Their equipment was equal to, or even less advanced than, that of their rivals; unlike the neighbouring Amazon tribes, they did not even use bows and arrows. Their warriors fought mainly with clubs (initially of stone, then of bronze fitted with stone spikes), slings, and short wooden lances, and they were protected by padded armour. To swell their ranks, they instituted compulsory military service for all men between the ages of 25 and 50, producing a vast pool of recruits; in combat, warriors would employ their long-range weapons (principally the slings) before closing in for hand-to-hand combat. If they suffered a setback in one area, they were able to call on substantial military resources from elsewhere in the empire. Just as the Aztecs fought "flower wars" (see box, right), the Inca seem to

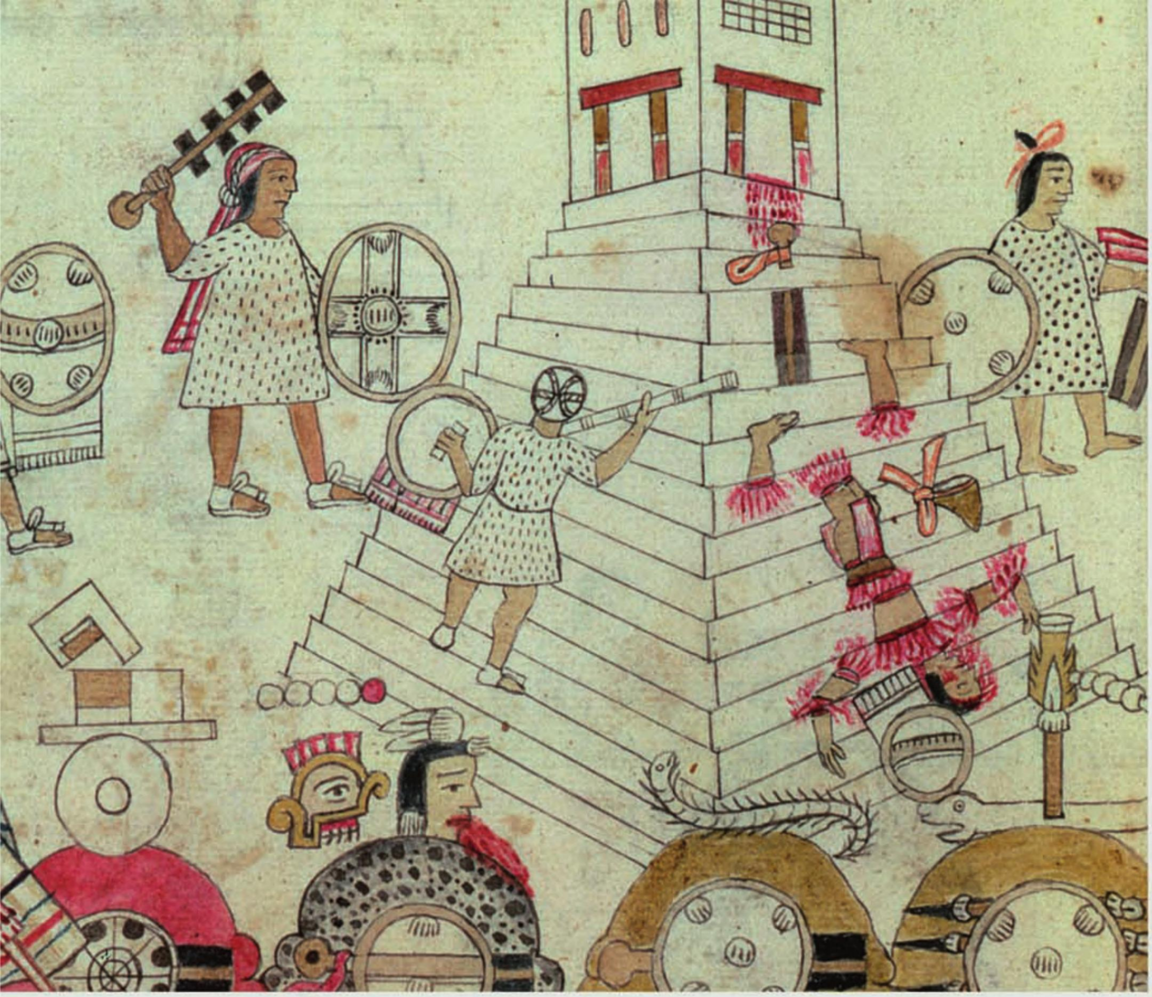


▲ **PLACE OF SACRIFICE**
The Aztec ruler Axayacatl (1468–81) is seen presiding over a human sacrifice of captives at the Pyramid of Huitzilopochtli, in the Aztec capital Tenochtitlán. The skulls of the victims were placed in racks at the foot of the temple steps.

> "And the curs **fought back furiously**, dealing us **wounds and death** with their **lances** and their **two-handed swords**"
>
> **BERNAL DÍAZ DEL CASTILLO**, *THE TRUE HISTORY OF THE CONQUEST OF MEXICO*, c.1568



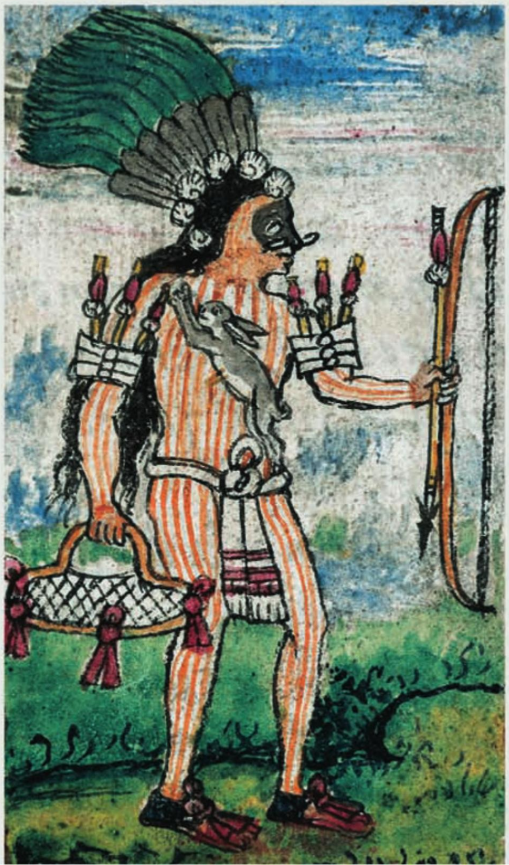
◀ **OBSIDIAN SPEAR**
Inca warriors usually carried one or two throwing spears made of wood, featuring blades edged with sharp flakes of stone capable of inflicting deep cuts.



have engaged in a form of ritual warfare known as "tinkuy". The spilling of blood on the ground was believed to ensure the earth's fertility, so the purpose of this type of conflict was not outright conquest. As in their major battles, the Inca forces' superiority in numbers would also have helped them in this ritualized form of combat.

THE COMING OF THE EUROPEANS

The arrival of Europeans, in Mexico in 1519, and in Peru in 1532, heralded the rapid collapse of the principal pre-Columbian civilizations. Although Spanish military technology was superior – they possessed firearms, horses, and metal armour – their numbers were vastly inferior. They achieved a series of victories through their advanced weapons, but also through military aggression, by disregarding Aztec and Inca ritual proprieties (such as the Inca reluctance to fight at the new moon), and by exploiting the resentment that existed among the subject peoples of the two empires. Once the vulnerability of the Inca and Aztec emperors had been established, the Spanish, who then arrived in greater numbers, never allowed their opponents to regain their strength. The Aztec empire lasted only until 1521, when it was overthrown by the Spanish; by 1572, the last Inca stronghold had also fallen.



◄ WARRIOR GOD
Mixcoatl was the Aztec god of hunting and warfare, and is normally pictured with warpaint, a bow, and his kills.

KEY **EVENTS**

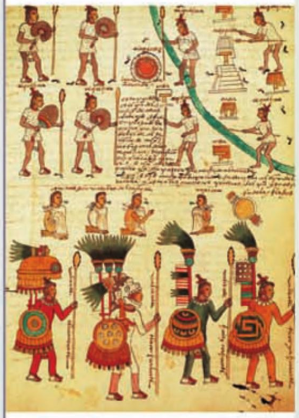
800–1550

- **c.800–830** The Classic Mayan civilization collapses. The main cities of the Maya – Calakmul, Tikal, and Yaxchilan – are abandoned one by one, for reasons that are not clear, but may have included the effects of overpopulation on poor land.
- **1428** The Aztecs of Tenochtitlán form a triple alliance with the neighbouring city-states of Texcoco and Tlacopan, marking the start of the Aztec rise to power in the Valley of Mexico.
- **c.1470** After a series of campaigns, the Pachacuti Inca conquer the Chimor capital at Chanchan, giving them dominance in the Andes.
- **1519–21** The Spanish, under the command of Hernan Cortes, overthrow the Aztec empire.
- **1529–33** Led by Francisco Pizarro, the Spanish overthrow the Inca, capturing and killing the Inca emperor Atahuallpa.

KEY **TRADITION**

AZTEC FLOWER WARS

The Aztecs and neighbouring tribes indulged in a type of ritual fighting known as "flower wars". At an agreed time and place, restricted numbers of warriors armed with non-lethal weapons would fight; captives on either side were taken off and used for human sacrifice.



▲ Aztec warriors as depicted in the *Codex Mendoza*, an Aztec pictorial record dated around 1541.

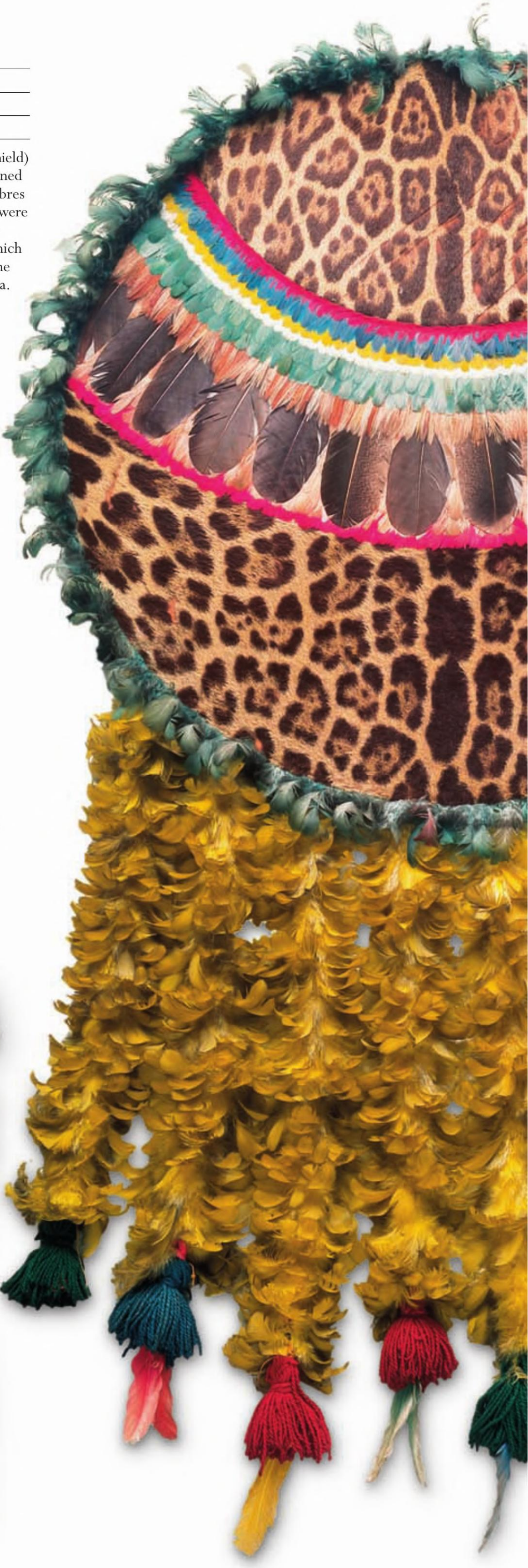
PRE-COLUMBIAN WEAPONRY

Weapons technology did not advance significantly in the Americas in the thousand years before European contact in the late 15th century. The most common weapons were thrusting spears, slings, and wooden clubs, with padded cotton armour forming the principal protection. Warfare, although common (especially between the Mayan cities of Mesoamerica), occurred on a small scale until the 14th and 15th centuries. This period saw the emergence of the more organized Inca and Aztec states, which were able to construct large empires dominating most of Peru and Mexico, respectively. It was their ability to deploy resources effectively, rather than superior military technology, that ensured their supremacy.

▶ AZTEC CHIMALLI

Date 1400–1500
Origin Mexico
Diameter 75cm (30in)

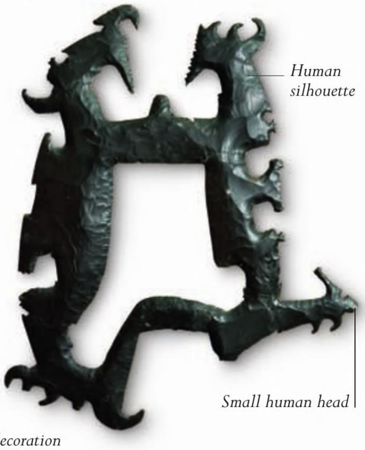
An Aztec warrior's *chimalli* (shield) was usually made of fire-hardened bamboo, tied together with fibres from the maguey plant. They were backed with cotton or leather and covered with feathers, which often hung down in tassels. The object pictured here is a replica.

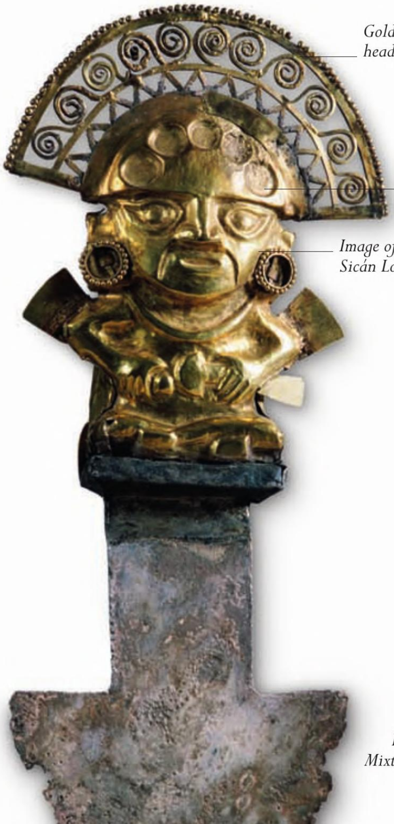


▶ MAYAN AXEHEAD

Date 9th century CE
Origin Mexico
Length 32cm (12½in)
Material Obsidian

Axes were not commonly employed by Mayan warriors in battle – this axehead bearing the form of human silhouettes was probably ceremonial. The Mayans instead used mainly spears and long clubs.




Gold headdress
Cavity for turquoise decoration
Image of Sicán Lord
Wide, semi-circular blade

▲ CEREMONIAL TUMI

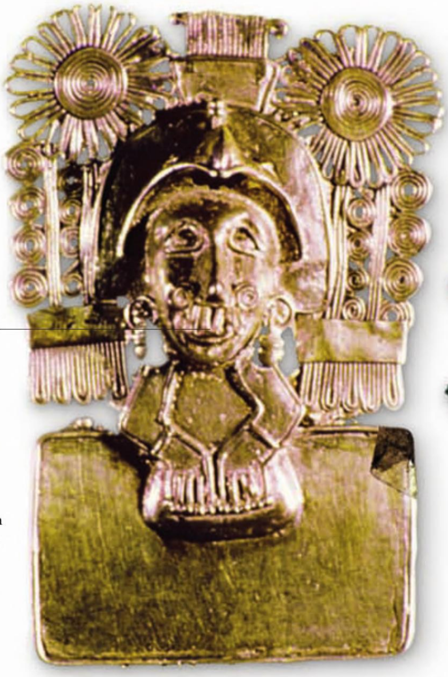
Date 9–11th century CE
Origin Peru
Length Approx. 35cm (13¾in)
Material Gold, bronze

Tumis were ceremonial knives with semicircular blades, characteristic of the Sicán and the Moche, pre-Inca peoples of Peru. They depicted the mythical founder of the Sicán people, the Sicán Lord, and were used in sacrifices to slit the victim's throat.

▼ MIXTEC GOLD BREASTPLATE

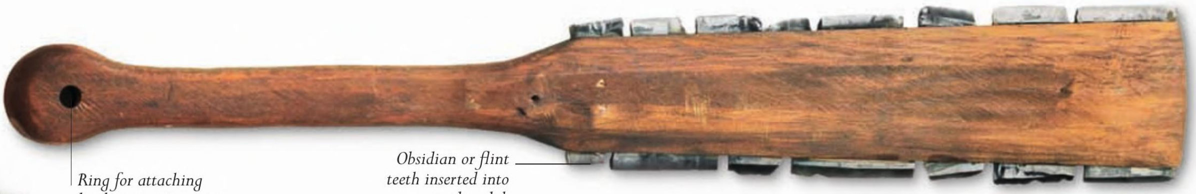
Date 1300–1450CE
Origin Mexico
Material Gold

This gold breastplate in the form of a deity came from the Mixtec people of Monte Alban, near modern-day Oaxaca. Mixtec nobles fought with thrusting spears, while commoners probably used slings and *atlatls*.

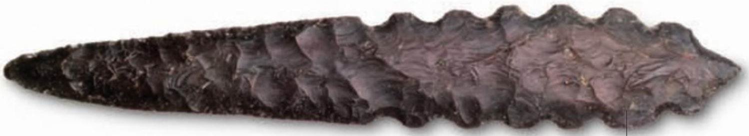


Feathers line outer edge of shield

Feathers end in a tassel


Ring for attaching leather carrying strap

Obsidian or flint teeth inserted into wooden club


Tooth-shaped blade

▲ AZTEC MAQUAHUITL

Date 1400–1500

Origin Mexico

Length Approx. 60cm (23½in)

Material Wood, obsidian

The *maquahuitl* (broadsword) was a long war club that was used as one of an Aztec warrior's primary shock weapons. Although made of wood, it was often studded with razor-sharp flakes of obsidian or flint.

▲ AZTEC FLINT KNIFE

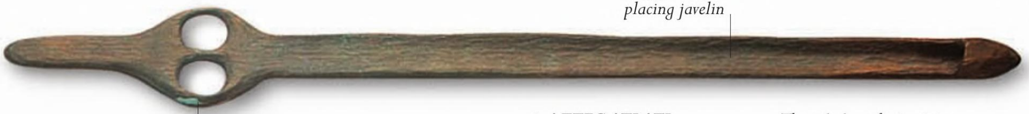
Date 1400–1530

Origin Mexico

Length Approx. 20cm (8in)

Material Flint

This flint knife is of an earlier type than the wood and flint *maquahuitl*. The sharp stone blade could inflict serious gashes, but was more difficult to repair than a wooden broadsword.


Long groove for placing javelin

Finger holes to grip onto atlatl *when making a throw*

▲ AZTEC ATLATL

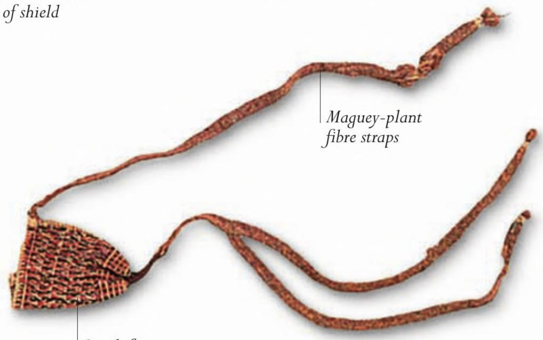
Date 1400–1500

Origin Mexico

Length 60cm (23½in)

Material Wood

The *atlatl* – a device into which a javelin or long dart was placed – was retained in the hand when the projectile was thrown, giving it around 60 per cent more force than a normal spear-throw. The darts or javelins were held in the hand and not in a quiver.


Maguey-plant fibre straps

Pouch for slingstone

◀ AZTEC SLING

Date 1400–1530

Origin Mexico

Length Approx. 50cm (19½in)

Material Maguey-plant fibres

Slings complemented bows as the main long-range Aztec missile weapons. Made of maguey-plant fibres, they were used to fire specially shaped spherical stones for maximum effect and had a range of up to 200m (656ft).

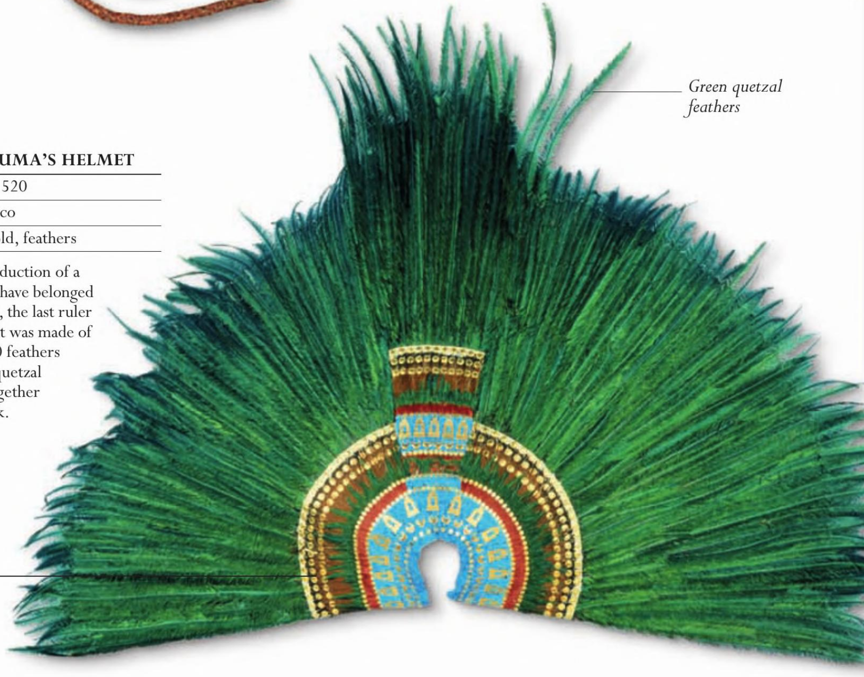
▶ MOCTEZUMA'S HELMET

Date 1500–1520

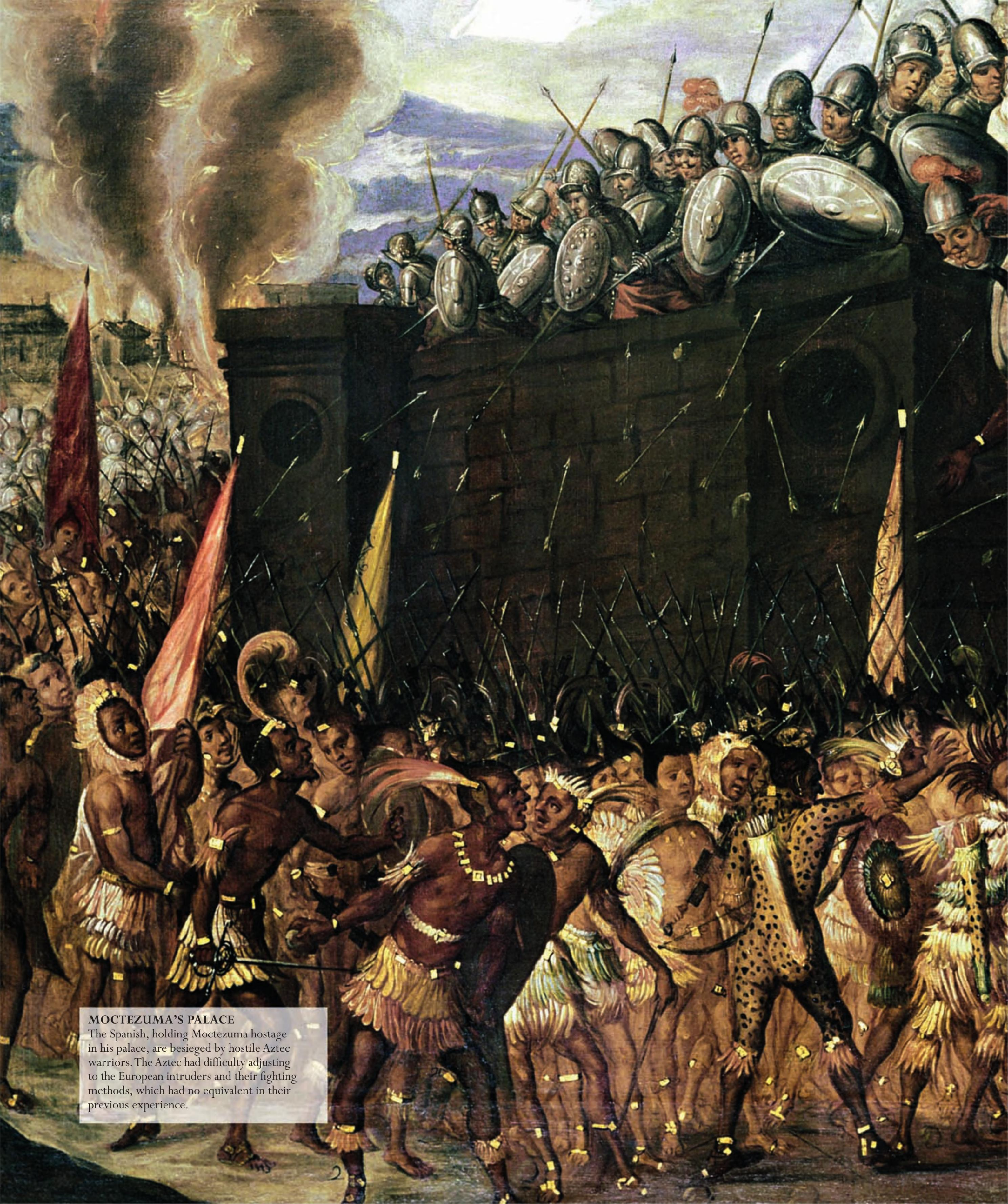
Origin Mexico

Material Gold, feathers

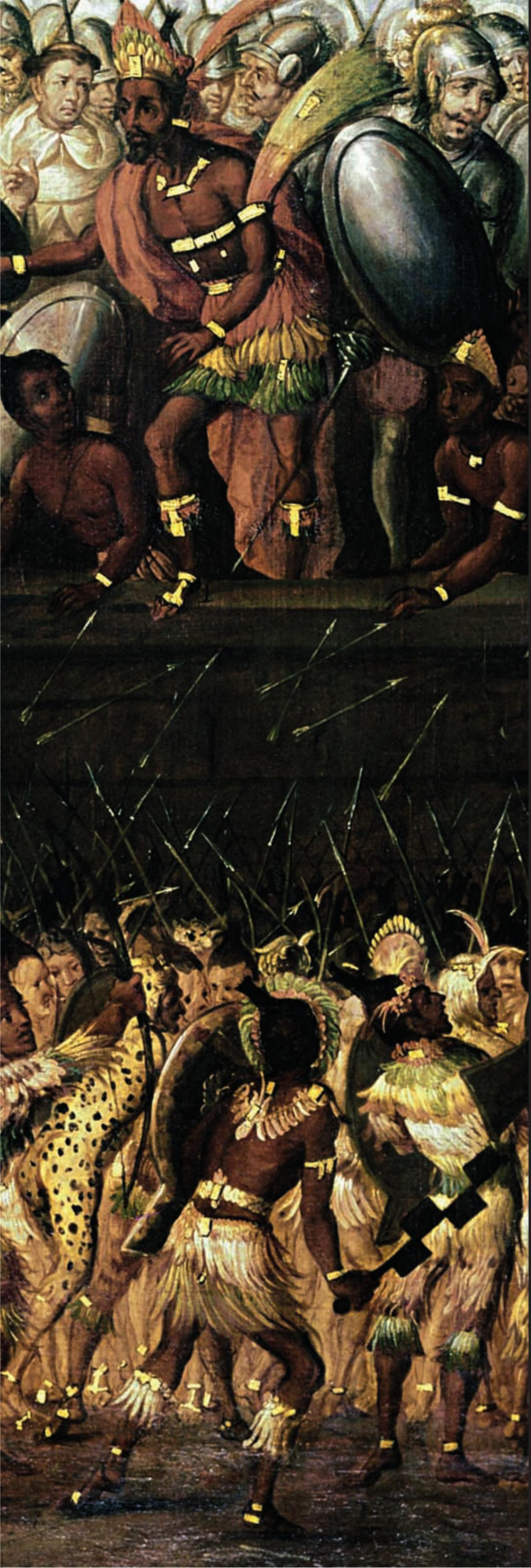
This is a reproduction of a helmet said to have belonged to Moctezuma, the last ruler of the Aztecs. It was made of gold, with 400 feathers of the sacred quetzal bird bound together with beadwork.


Green quetzal feathers

Beadwork binding



MOCTEZUMA'S PALACE
The Spanish, holding Moctezuma hostage in his palace, are besieged by hostile Aztec warriors. The Aztec had difficulty adjusting to the European intruders and their fighting methods, which had no equivalent in their previous experience.



NEW WORLD CONQUEST

AZTECS AND CONQUISTADORS

From 1519, the Aztec Empire faced an invasion by Spanish conquistadors – men from an alien military tradition with superior technology. The struggle for control of the capital, Tenochtitlán, revealed the Aztec army's dependence on stone weaponry and their ritualistic attitude to warfare.

The Aztec Emperor Moctezuma II at first welcomed the Spanish and their Indian allies, the Tlaxcaltec, into his palace in Tenochtitlán, but relations soon soured. The Spanish took Moctezuma hostage, and the Aztec population became increasingly hostile. In June 1520, fighting broke out. Moctezuma was killed – whether by the Spanish, or his own people, is not known – and the Spanish were besieged in the royal palace. On the night of 30 June, they attempted to escape along the causeways that linked the city, built on an island in Lake Texcoco, to the shore. Aztec warriors in war canoes attacked the Spanish, shooting arrows and climbing onto the causeways to strike them with clubs. Of about 1,000 conquistadors, probably two-thirds were killed, taken prisoner, or wounded.

THE SHOCK OF THE NEW

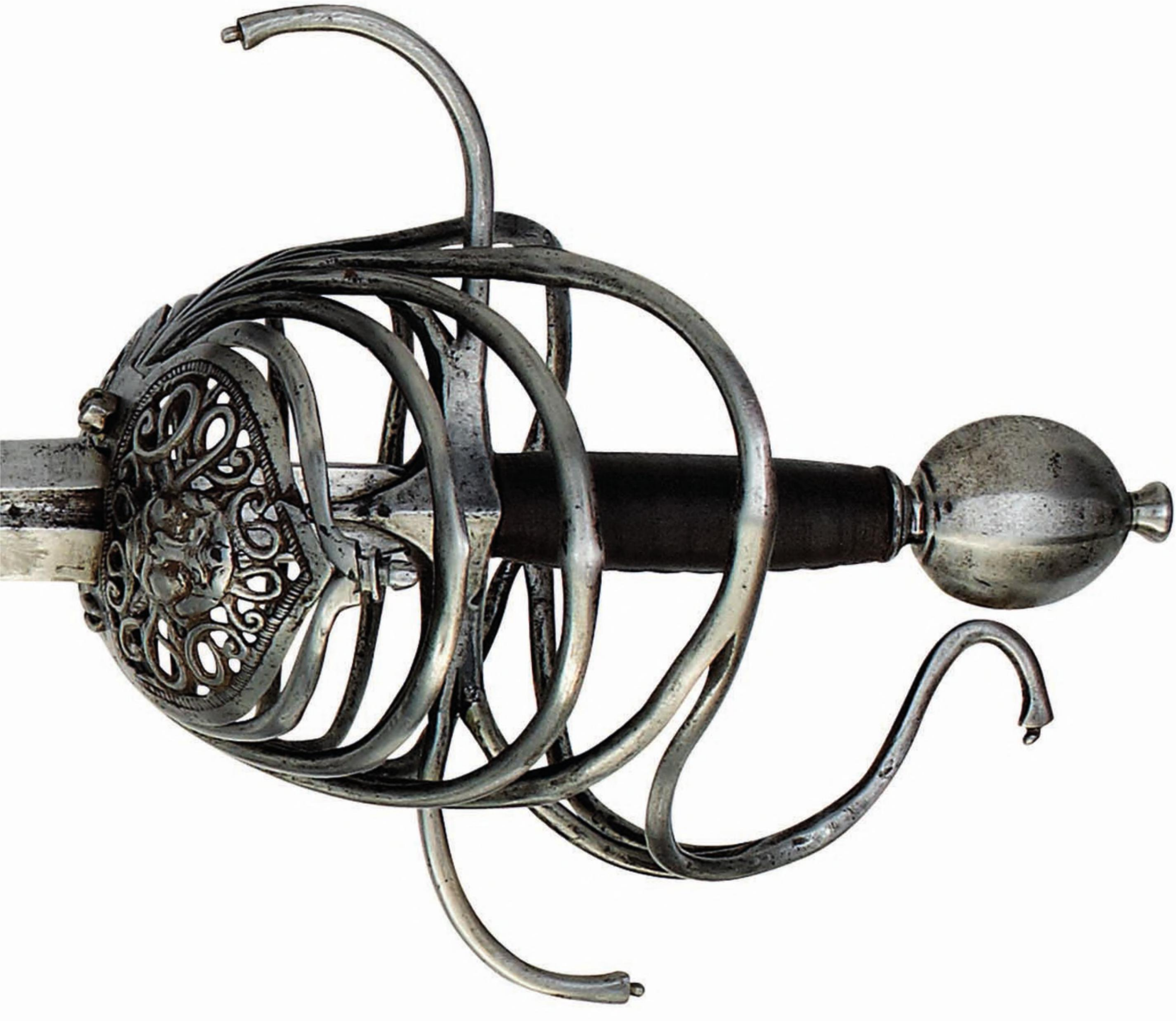
Under a new emperor, Cuitláhuac, the Aztecs sought to complete their victory by pursuing the remnants of the Spanish force. An Aztec army set out, splendidly arrayed, the officers wearing elaborate feathered displays on bamboo frames and marching under colourful standards. They caught up with the Spanish at the plain of Otumba. The Aztecs greatly outnumbered their enemy, probably by at least twenty to one. Their noble warriors, hardened to warfare from an early age, were physically fearless fighters. They had no metal weapons, but their wooden clubs and spears were edged with razor-sharp black obsidian blades. As well as bows and arrows they had javelins that could be launched to considerable distance using a throwing stick, or *atlatl*. The primary objective of a warrior was not to kill his opponents but to maim them and capture them alive. Nonetheless, after battle was joined the Spanish suffered steady attrition. The tide was turned not by the conquistadors' few gunpowder weapons or their steel swords, but by their horses – animals unknown to the Aztecs before the Europeans' arrival. The Spanish commander Hernán Cortés led a small cavalry charge into the Aztec ranks and ran down their commanders. The psychological impact of this bold and unexpected action routed the Aztecs, who soon abandoned the field in disarray.

THE TAKING OF TENOCHTITLÁN

The following year, reinforced with large numbers of Tlaxcaltec and other native allies, Cortés placed Tenochtitlán under siege. In the defence of the city the Aztecs proved far more resolute than in open field. They fought fiercely to hold the causeways giving access to the city across the lake, until these were made untenable by the fire of small cannon mounted in Spanish boats. Then they defended their city street by street. Confronting crossbows, arquebuses, and steel swords with their weapons of wood and stone, they repeatedly repelled incursions by the Spanish and their allies, throwing missiles from the rooftops and ambushing isolated groups of soldiers. The Aztecs remained undefeated through 10 weeks of siege, but eventually the Spanish blockade of the city led to a shortage of food, forcing them to surrender. In August 1521, the Aztec civilization came to an end.

1500–1680

PIKES AND GUNPOWDER



INTRODUCTION

Around 1500, warfare entered a phase of intensive innovation. The growing impact of gunpowder weapons led to a re-evaluation of siege warfare, battlefield tactics, and the training of soldiers. At sea, sailing ships armed with cannon gave Europeans unprecedented control of the seas.

Although military developments varied worldwide, there were certain trends. In 16th-century Japan, for example, commanders realized that peasant footsoldiers, if equipped with firearms and properly disciplined, could be a match for the elite mounted samurai. A similar idea underpinned the strict drills of European musket-armed infantry, who learned to fire in volleys and manoeuvre together on the battlefield. In Europe, the use of massed pikemen became standard: the issue of how to combine muskets and pikes in battle preoccupied European military theorists for a century and a half, before the advent of the bayonet, in the late 17th century, made the issue redundant.

The conquest of the Aztec and Inca empires by small Spanish forces, in the 1520s and 1530s, was atypical of European military achievement – the most effective army in the 16th century was arguably that of the Turkish Ottoman Empire. The largest wars of the 17th century were fought by the Manchu in China, while Europe's incessant religious and dynastic conflicts were stimuli for technological development.

The armoured knight evolved into the cavalryman, armed with pistol and sword. Adapting successfully to the challenge of cannon, fortifications became ever more elaborate, as did the techniques used to besiege them. In the Mediterranean, war fleets still consisted of oared galleys but, in the Atlantic, sailing ships evolved into remarkable weapons platforms, with a single ship mounting as many cannon as an entire land army. Permanent regular armies – drilled, disciplined, and uniformed – eventually replaced the former European military traditions of mercenaries, feudal retainers, levies, and militias. The wealth of increasingly centralized European states sustained these expanding military establishments.

KEY **DATES**

1500

c.1500 The *trace italienne* fortification system begins to spread in Europe

1503 At Cerignola, in Italy, the Spanish make effective use of cannon and firearms fired from behind field fortifications

1509 Portuguese sailing ships dominate the Indian Ocean, after the Battle of Diu, in the Arabian Sea

1511 The English ship *Mary Rose* is one of first to be built with gunports

1516–17 Possession of cannon and firearms enables the Ottoman Turks to conquer Syria and Egypt

1519–21 Spanish Conquistadores under Hernan Cortes destroy the Aztec Empire, in Mexico

1525 Arquebusiers and pikemen play an important role in the defeat of the French by the Spanish, at Pavia, Italy

1526 The Ottoman army of Suleyman the Magnificent defeats the Hungarians at the Battle of Mohacs, in Hungary

1526 In India, victory at the Battle of Panipat allows Babur to found the Mughal Empire

c.1530 The matchlock musket comes into use in Europe

1543 Portuguese sailors introduce firearms to Japan

c.1560 German horsemen introduce the "caracole" tactic for fighting with wheellock pistols

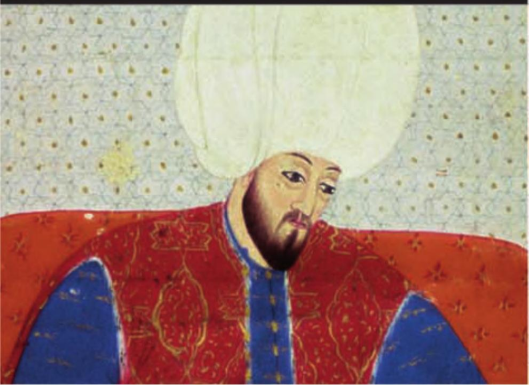
1568 The Dutch Revolt begins a long war of independence against Spanish rule in the Netherlands

1571 Muslim and Christian galley fleets clash in the Mediterranean, at the Battle of Lepanto

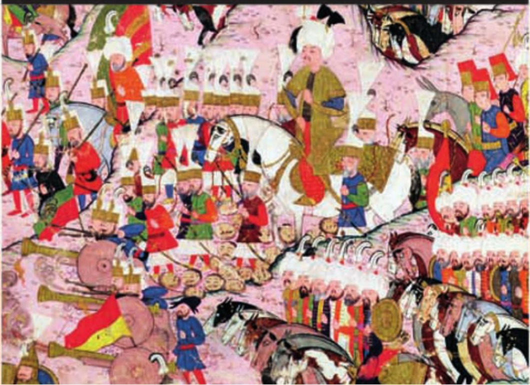
1575 Japanese warlord Oda Nobunaga makes decisive use of firearms at the Battle of Nagashino

1582 The first mid-ocean naval batle is fought off the Azores between the French and the Portuguese

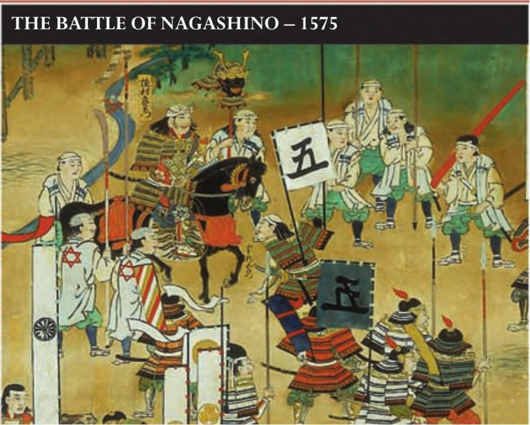
SÜLEYMAN I – 1494-1566



THE BATTLE OF MOHACS – 1526



THE BATTLE OF NAGASHINO – 1575



1587 In Persia, Shah Abbas I modernizes Safavid forces using European experts

1588 An attempted Spanish invasion of England fails, with the defeat of the Armada

1592 Korean admiral Yi Sunsin uses ironclad "turtle ships" in the defeat of a Japanese fleet

c.1600 Dutch leader Maurice of Nassau improves the drill of pike and musket infantry

1600 European armies introduce dragoons – horsemen who fight dismounted with carbines

1615 The Siege of Osaka Castle ends the period of civil wars in Japan

1620 The Battle of White Mountain is the first decisive encounter of the Thirty Years War, in Europe

1631 King Gustavus Adolphus of Sweden employs cavalry charges and field artillery in victory at Breitenfeld, Germany

1639 Dutch Admiral Maarten Tromp uses line of battle tactics against a Spanish fleet, at the Battle of Downs

1643 At the Battle of Rocroi, France, the French end the dominance of Spanish infantry *tercios* in European warfare

1644 Manchu warriors seize Beijing, founding the Qing dynasty in China

1645 The New Model Army is formed by the Parliament side in the English Civil War

1652–74 England and the Netherlands fight for naval supremacy in the Anglo-Dutch Wars

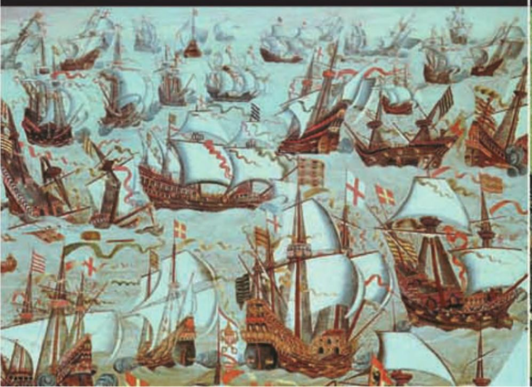
c.1660 Vauban emerges as France's leading fortress designer and conductor of sieges

c.1670 The plug bayonet is introduced into European warfare

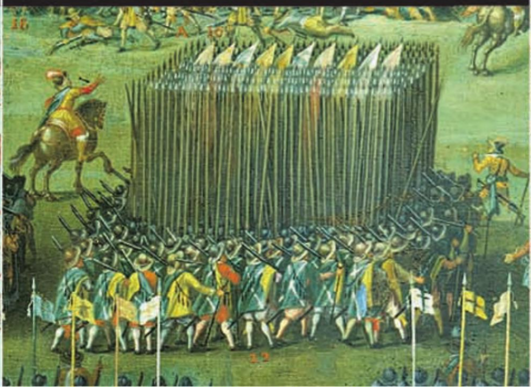
1673 Vauban successfully conducts the Siege of Maastricht for King Louis XIV

1680

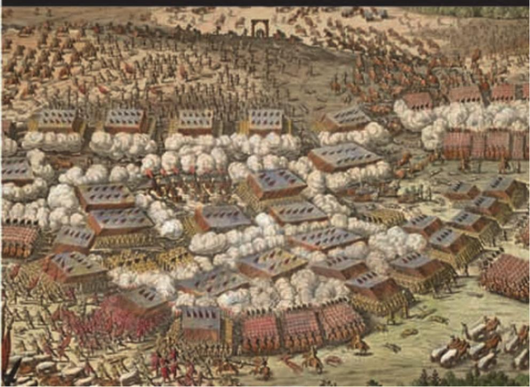
THE SPANISH ARMADA – 1588



THE BATTLE OF WHITE MOUNTAIN – 1620



THE BATTLE OF BREITENFELD – 1631



KEY DEVELOPMENT

PIKES AND MUSKETS

In the 16th and 17th centuries, Europe was a continent almost constantly at war. Over the course of these decades of conflict, European armies experimented with fighting methods that bestowed new importance on infantry armed with pikes and firearms.

Medieval European foot soldiers were often effective but were generally seen as being of low repute. In the early 16th century, however, the Renaissance rediscovery of the military techniques of Ancient Greece and Rome – the Greek phalanx and the Roman legion – suddenly made infantry fashionable. The most admired fighting men of 16th-century Europe, such as the German Landesknechte and the Spanish *tercios*, fought on foot, utilizing massed bodies of pikemen. This technique had been pioneered by the Swiss, but now firearms were added to the formations: although some foot soldiers continued to use the bow, the matchlock arquebus overtook it as the key infantry missile weapon during the Italian Wars (1494–1559). The arquebus was neither accurate nor powerful, but it could weaken an enemy pike square or help hold off a cavalry charge. Mobile field cannon – of bronze and firing iron shot – also began to make their mark on the battlefield.

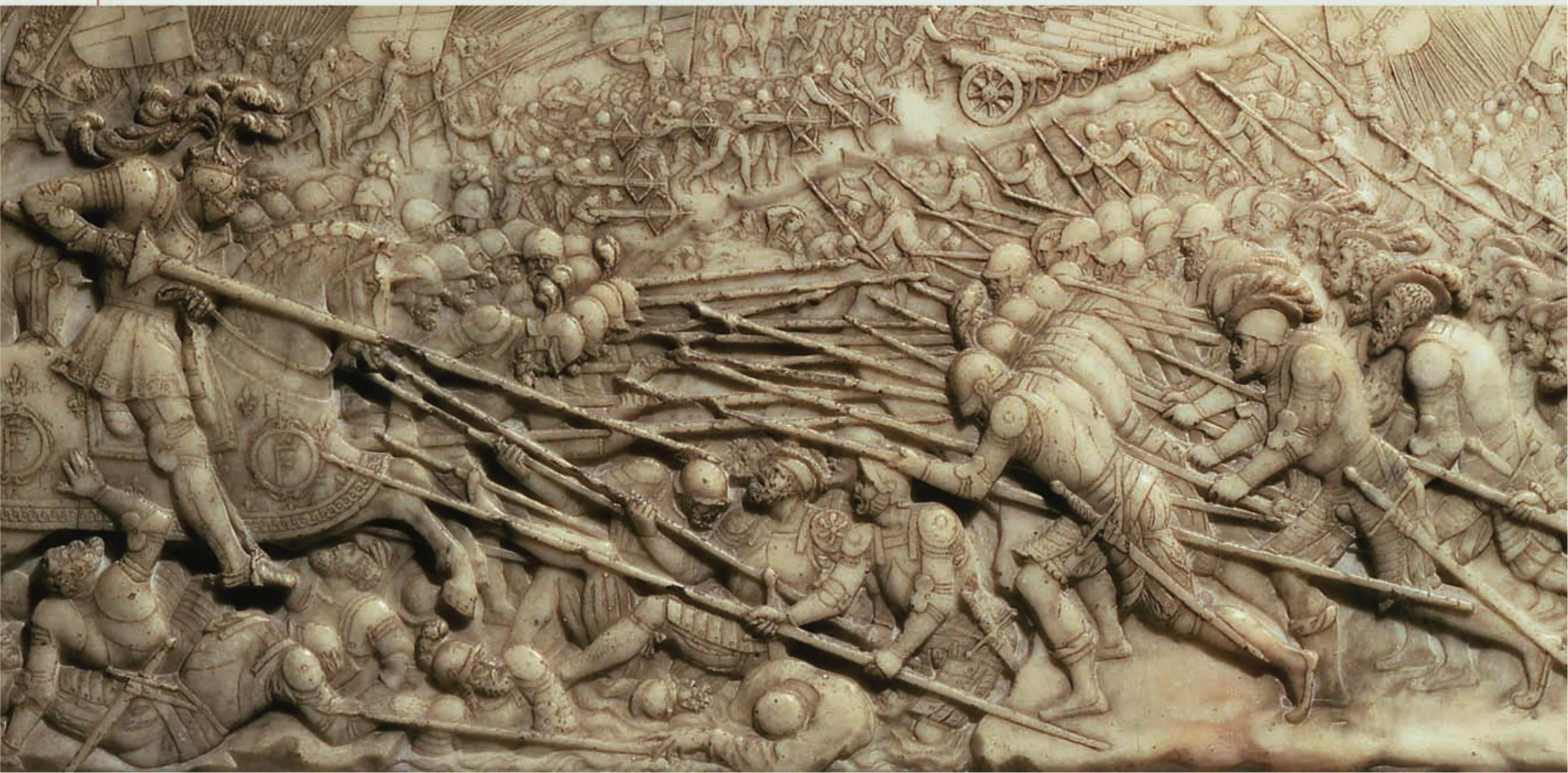
INFANTRY DISCIPLINE

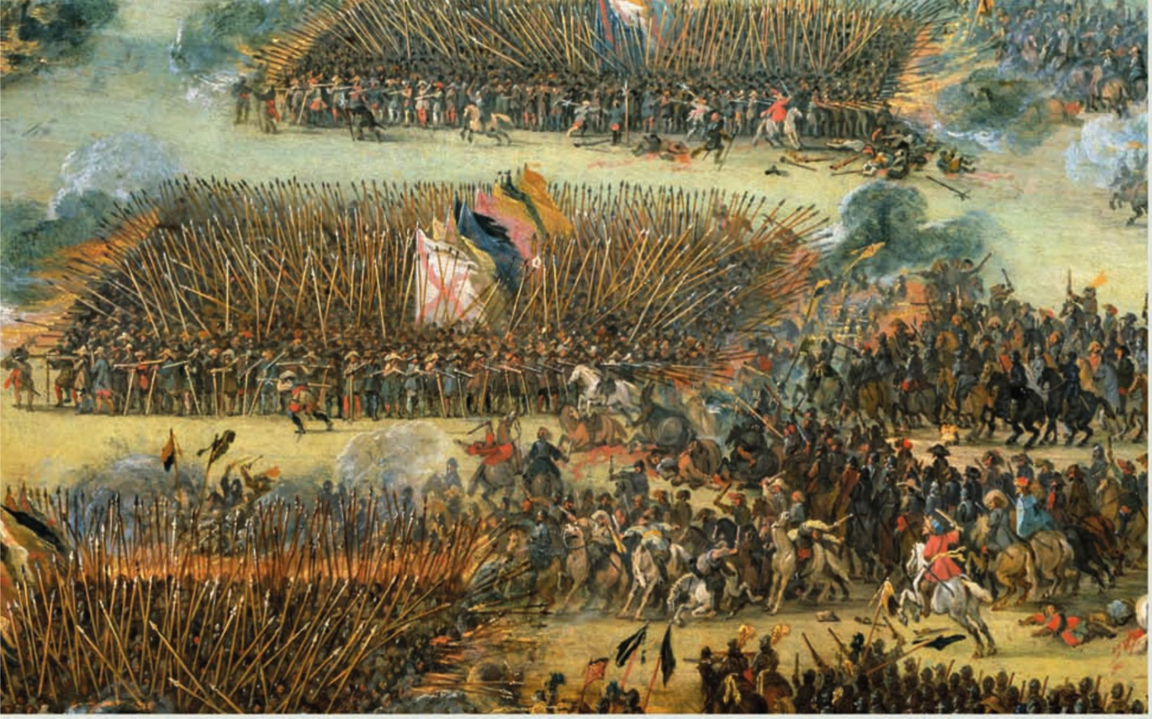
When they could afford it, 16th-century infantry wore extensive plate armour for protection against arquebus fire, as well as against pikes, swords, and halberds. But during the second half of the 16th century, the matchlock musket came into use. A heavier weapon that required a forked rest to aim, the musket could penetrate most plate armour at moderate range, and the proportion of foot soldiers carrying them gradually increased. The importance of discipline in the effectiveness of

▲ MUSKETEER'S KIT
Musket soldiers in the English Civil Wars (1642–51) rarely wore armour. The red coat was the uniform of men of Parliament's New Model Army.

> "Advanced within **musket shot** of the enemy, the **foot on both sides** began to give fire"
>
> **FUTURE KING OF ENGLAND, JAMES II**, DESCRIBING THE BATTLE OF EDGEHILL, 1642

▼ BATTLE OF MARIGNANO
The tomb of King François I of France is decorated with this image of his victory at Marignano in 1515. In it, François leads his knights in a charge with couched lance against Swiss pikemen backed by field artillery.





◄ **SPANISH TERCIOS**
Spanish royal troops fight in a deep pike formation during the Eighty Years' War (1568–1648) against the Dutch. The Spanish *tercios* were considered the best infantry in Europe.

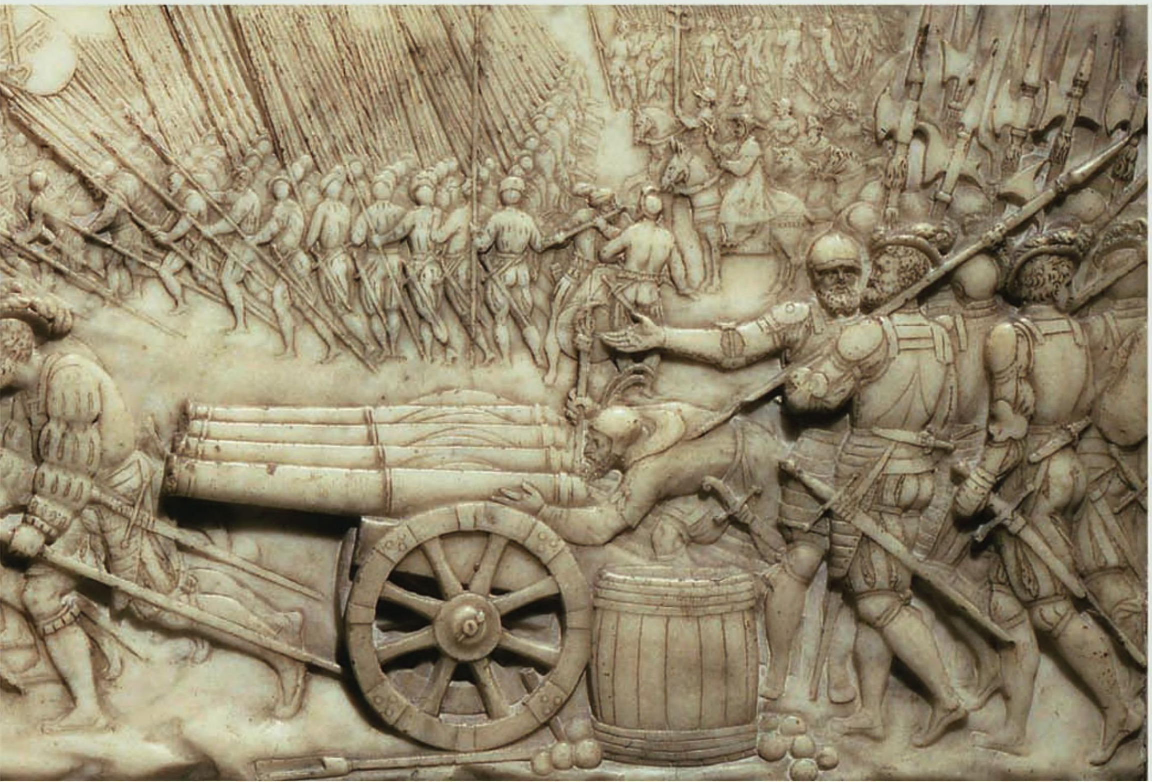
infantry was already apparent from the pike square – a man with a 5.5m (18ft) pike was formidable as part of a tight formation, but useless on his own. However, as the use of firearms increased, so did the need for further precision in drills: loading and firing the gun was a complex operation, particularly *en masse*, and its success in battlefield formation depended on tight discipline. The 17th century saw musket-armed troops manoeuvring in formation alongside pike squares, firing in volleys – either together for shock effect, or in sequence to maintain a continuous fire.

The impact of gunpowder weapons on European siege warfare, however, was far more rapid than that on field battles. Tall stone castle walls were obsolete by 1500, but during the Italian wars they were gradually replaced by star forts that were designed not only to resist bombardment by cannon, but also to enable the defenders to make optimal use of cannon and firearms themselves. As a result, sieges became even longer and more elaborate than before, with besieging infantry forced to spend long months in trenches that protected them from the defenders' firepower.

KEY **EVENTS**

16TH–17TH CENTURY

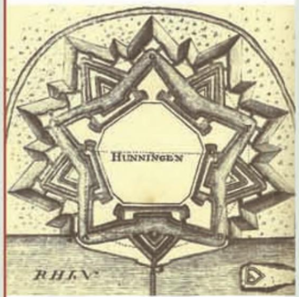
- **1503** At Cerignola, the Spanish demonstrate the effectiveness of firearms and cannon deployed defensively behind field fortifications.
- **1513** Swiss pikemen attacking in dense columns beat the French at Novara.
- **1525** French armoured cavalry suffer heavy losses to Spanish arquebusiers in the defeat of François I by Habsburg forces at Pavia.
- **1580s** The matchlock musket comes into use.
- **c.1600** Dutch commander Maurice of Nassau trains and organizes his pike-and-musket infantry to carry out flexible battlefield manoeuvres.
- **1619–48** During the Thirty Years' War, the proportion of musket-armed infantry increases, sometimes outnumbering pikemen.
- **c.1660** The flintlock musket begins to replace the matchlock musket as the key European infantry weapon.



KEY **STRUCTURE**

STAR FORT

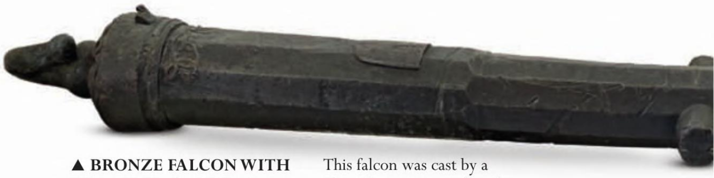
Originally called the "trace italienne", the star fort's projecting triangular bastions enabled its defenders to cover all approaches to the walls with converging musket fire. The walls themselves were thick and low, surrounded by a wide ditch and an earth slope – the *glacis*.



▲ Plans for fortifications at Hunningen were drawn up in the 1670s. Star forts often had additional outworks, as here across the Rhine.

FIELD ARTILLERY AND NAVAL CANNON

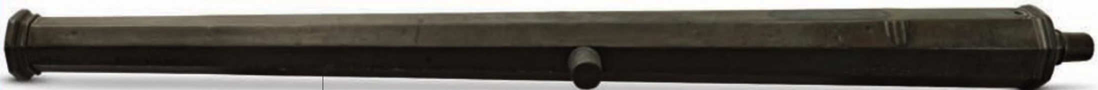
Artillery was established as an effective battlefield weapon by the early 16th century, leading to the appearance of a wide range of ordnance, including practical field artillery and lighter pieces for naval use. Improvements in gun-casting technology led to the replacement of wrought-iron guns with stronger bronze cannon, while the introduction of superior corned gunpowder in the late 16th century allowed the construction of longer-range guns with short barrels. By the time of the Thirty Years' War (1618–48) and English Civil War (1642–51), artillery was firmly established, with gun units integrated into infantry regiments.



▲ BRONZE FALCON WITH TEN-SIDED BARREL

Date	c.1520
Origin	England or Flanders
Length	2.78m (9ft)
Calibre	6.6cm
Range	240m (262½ yards)

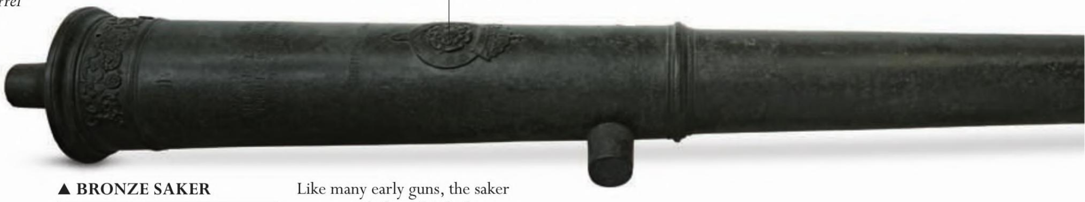
This falcon was cast by a Flemish master gun-founder for Henry VIII as part of a consignment of 28 guns. It fired balls weighing 1kg (2¼lb).



▲ BRONZE FALCON

Date	c.1520
Origin	Flanders or France
Length	2.54m (8¼ft)
Calibre	6.3cm
Shot	c.1.3kg (2¾lb)

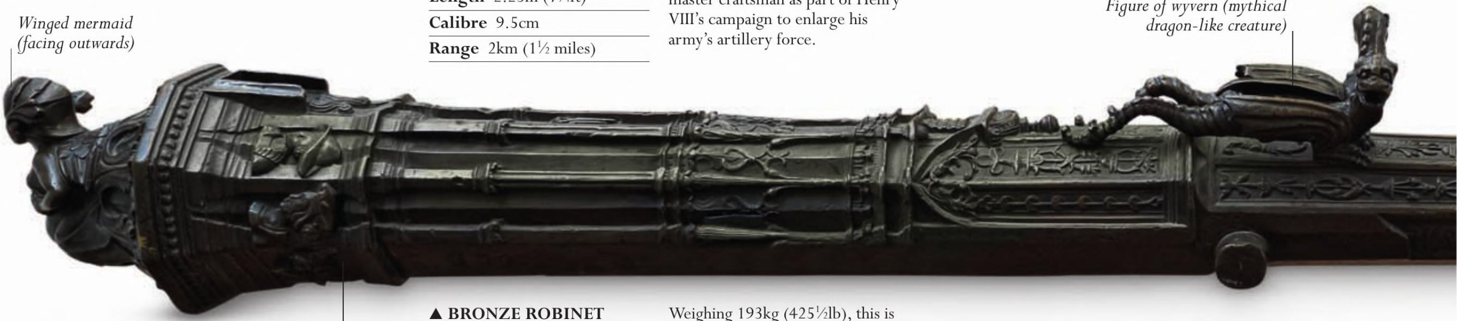
The falcon was a light cannon typical of the early 16th century. This model was ordered by Henry VIII, possibly from Flanders, as England did not have an established gun-manufacturing industry at the time.



▲ BRONZE SAKER

Date	1529
Origin	England
Length	2.23m (7¼ft)
Calibre	9.5cm
Range	2km (1½ miles)

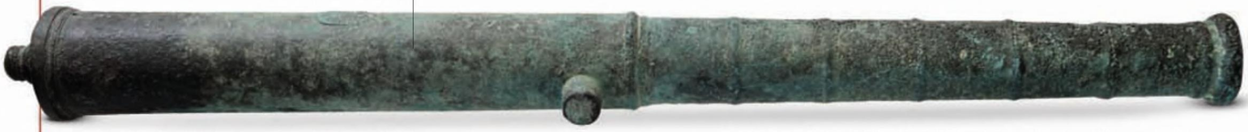
Like many early guns, the saker was named after a bird of prey – in this case, the saker falcon. This one was acquired from an Italian master craftsman as part of Henry VIII's campaign to enlarge his army's artillery force.


Winged mermaid (facing outwards)
Figure of wyvern (mythical dragon-like creature)
Elaborately decorated barrel

▲ BRONZE ROBINET

Date	1535
Origin	France
Length	2.39m (7¾ft)
Calibre	4.3cm
Shot	0.45kg (1lb)

Weighing 193kg (425½lb), this is an extremely ornate example of the robinet, a light cannon. This model was made in Metz, France. It was seized in Paris by Allied troops in 1815.



▲ BRONZE MINION

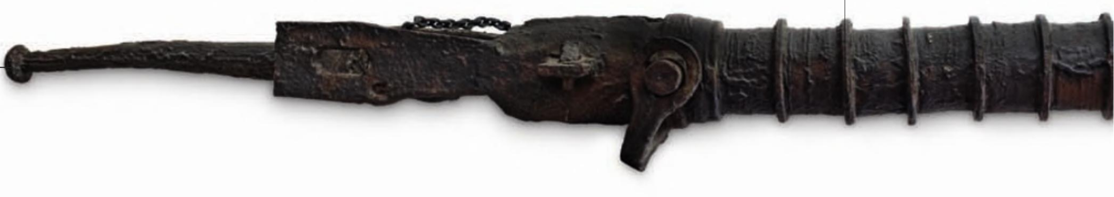
Date	c.1550
Origin	Italy
Length	2.5m (8¼ft)
Calibre	7.6cm
Shot	1.5kg (3¼lb)

Minions, light cannon that were particularly well adapted for use at sea, saw service on many English ships during their engagement with the Spanish Armada (see pp.148–49).

▼ IRON BREECH-LOADING SWIVEL GUN

Date	16th century
Origin	Europe
Length	1.63m (5¼ft)
Calibre	7.6cm
Shot	1.5kg (3½lb) or grape shot

Pivots that allowed a gun to fire across a wide arc turned a fixed barrel into a swivel gun, especially useful aboard a ship when firing on other moving vessels. This model was used in an antipersonnel role, shooting stone ammunition.



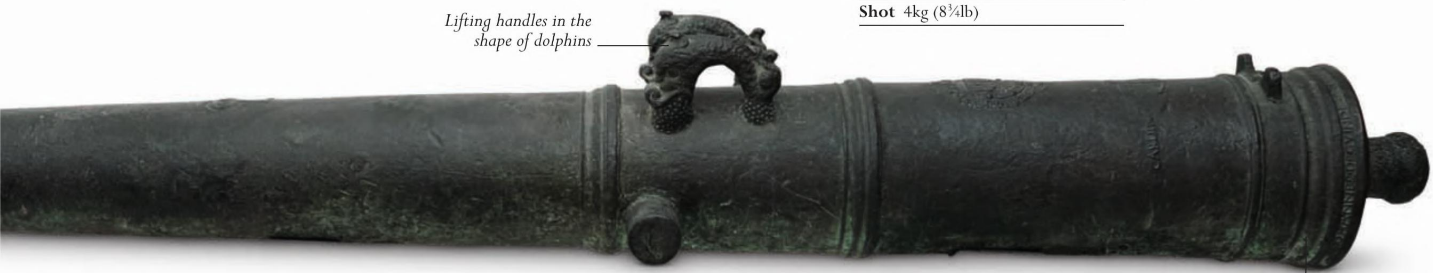
Bronze barrel

▼ BRONZE DEMI-CULVERIN

Date	1636
Origin	France
Length	2.92m (9½ft)
Calibre	11cm
Shot	4kg (8¾lb)

This naval version of a demi-culverin, a medium cannon, was cast for Cardinal Richelieu, who reorganized the French fleet and established a foundry at Le Havre.

Lifting handles in the shape of dolphins



Reinforcing bronze strips

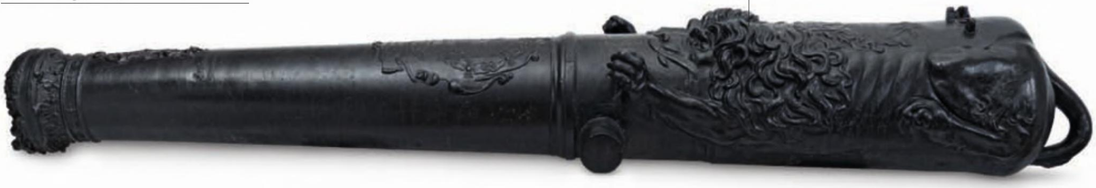
Widely flared muzzle

▼ BRONZE DEMI-CANNON

Date	1643
Origin	Flanders
Length	3.12m (10¼ft)
Calibre	15.2cm
Shot	12kg (26lb)

This demi-cannon, a heavy piece designed for naval use, was cast in the famous Flemish gun-foundry at Malines. It was capable of firing heavy shots, which could cause devastating damage at short range.

Ornamental figure of pouncing lion

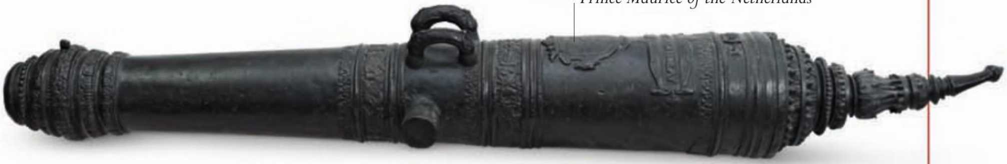


▶ MALAYSIAN BRONZE SAKER

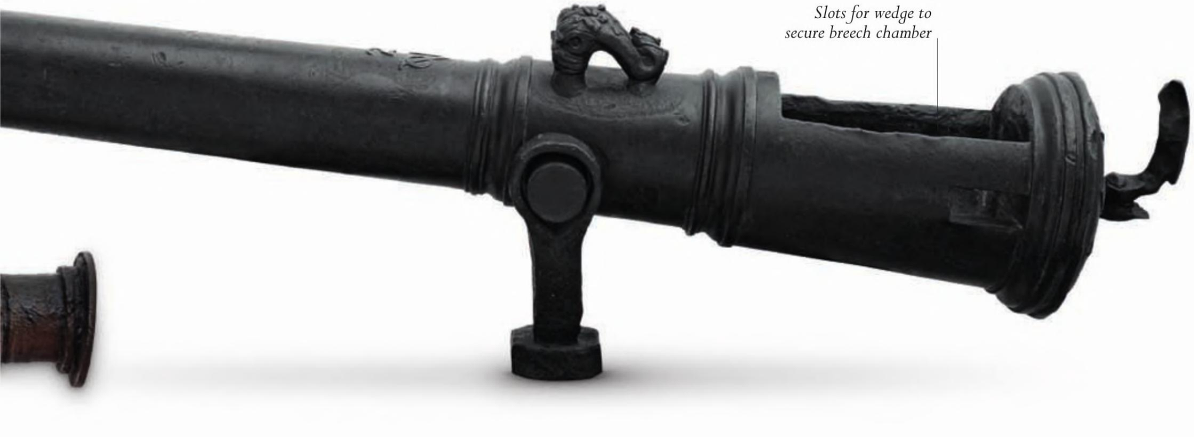
Date	c.1650
Origin	Malaysia
Length	2.29m (7½ft)
Calibre	8.9cm
Shot	2kg (4½lb)

These light cannon were designed for long-range attack. This ornate model was cast in Malacca, Malaysia, by local craftsmen who probably followed a Dutch model.

Decoration depicting arms of Prince Maurice of the Netherlands



Slots for wedge to secure breech chamber



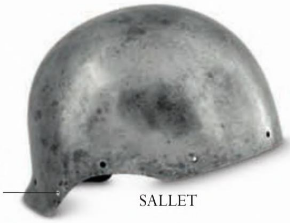
◀ BRONZE BREECH-LOADING SWIVEL GUN

Date	c.1670
Origin	Netherlands
Length	1.22m (4ft)
Calibre	7.4cm
Shot	1.16kg (2½lb) or grape shot

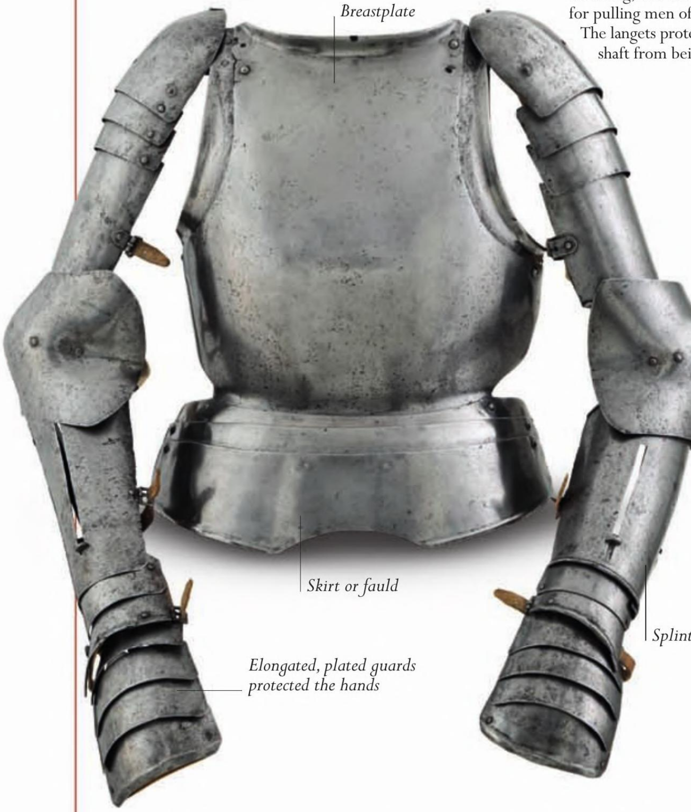
This swivel gun was owned by the Dutch East India Company, and was most probably used as an antipersonnel weapon.

EUROPEAN INFANTRY ARMOUR AND WEAPONS

Peacetime armies hardly existed prior to the 16th century: professional troops were either bodyguards or employed for garrison duties. However, during wartime troops were recruited and mercenaries hired. Permanent infantry units, such as the Spanish *tercio* (see p.117), were established in the early 16th century. They were drilled in battlefield tactics and trained in the effective use of their weapons. Such forces, together with the increased availability of handguns, challenged the supremacy of the fully armoured knights. Manufacturers in Italy, Germany, and the Low Countries increased their production of swords, staff weapons, handguns, and armour, transporting them all over Europe to equip these new military units.


Rivet-holes where visor was attached

SALLET


Breastplate
Couter
Skirt or fauld
Splints
Elongated, plated guards protected the hands

▲ ALMAIN RIVET (MUNITION ARMOUR)

Date c.1520

Origin Italy

Material Iron, leather

In 1512, King Henry VIII ordered 2,000 of these simple armours from a merchant in Florence. The arm defences, called "splints", consisted of gutter-shaped plates attached to a dished couter over the elbow. The plates and the couter were joined by leather on the inside. Instead of gauntlets, a series of laminations covered the hands.

▶ HALBERD

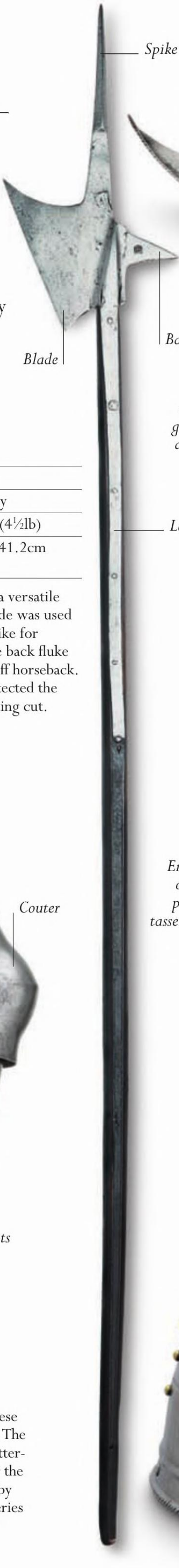
Date c.1500

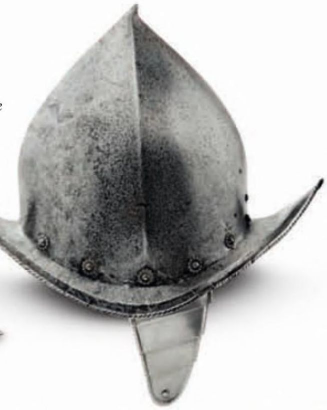
Origin Germany

Weight 2.01kg (4½lb)

Length (Head) 41.2cm (16¼in)

The halberd was a versatile weapon – the blade was used for cutting, its spike for thrusting, and the back fluke for pulling men off horseback. The langets protected the shaft from being cut.


Spike
Blade
Back fluke
Langet



MORION

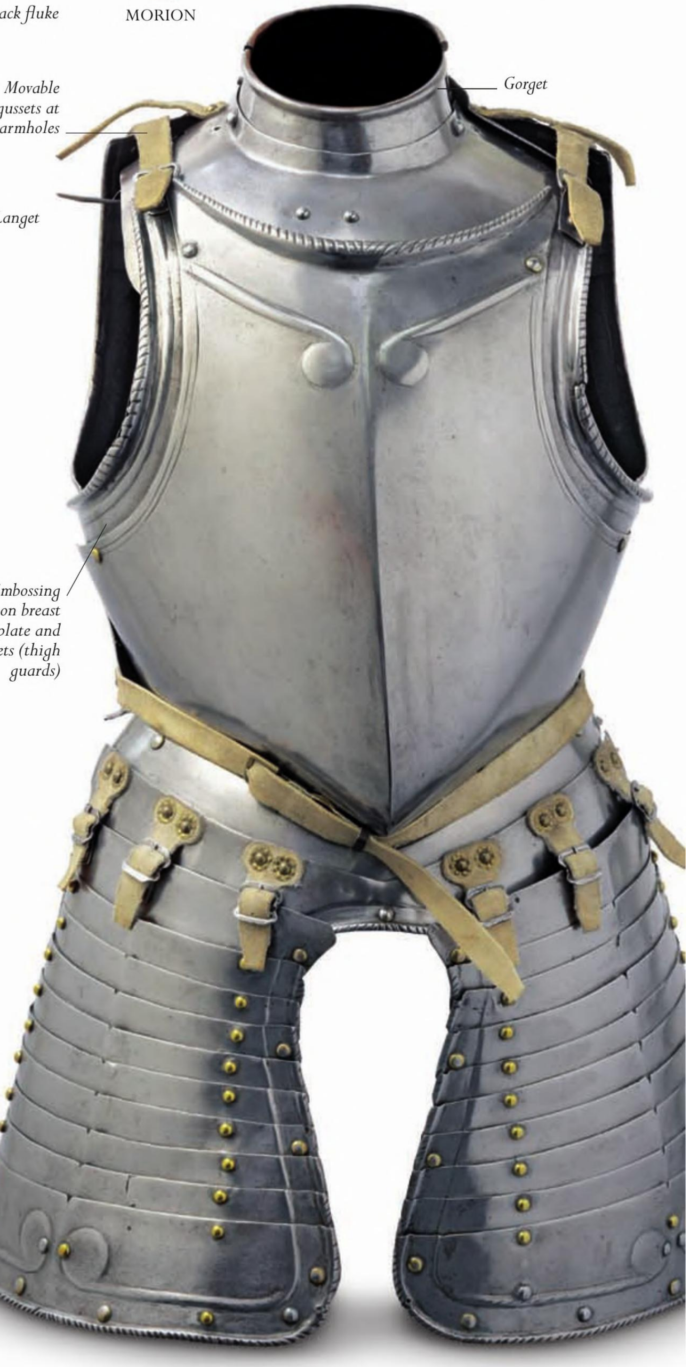
▼ SPANISH TERCIO ARMOUR

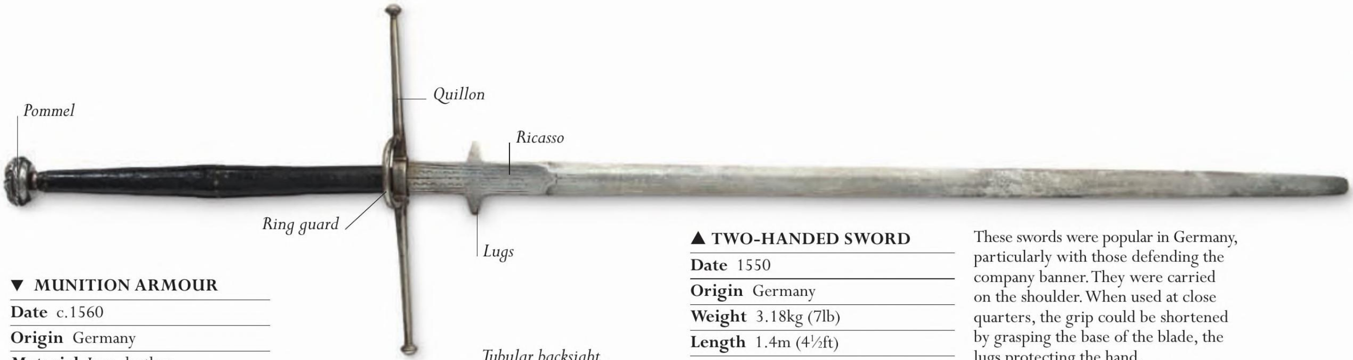
Date c.1570

Origin Italy

Material Iron, leather

Italy, and especially Milan, made munition armour of this type in large quantities. This cuirass was worn with full arms and an open helmet such as the morion shown. The *tercios* were armed with a pike or gun and a sword.


Gorget
Movable gussets at armholes
Embossing on breast plate and tassets (thigh guards)


Pommel
Quillon
Ricasso
Ring guard
Lugs

▲ TWO-HANDED SWORD

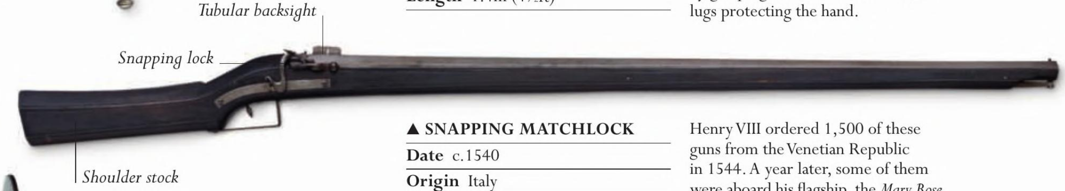
Date 1550
Origin Germany
Weight 3.18kg (7lb)
Length 1.4m (4½ft)

These swords were popular in Germany, particularly with those defending the company banner. They were carried on the shoulder. When used at close quarters, the grip could be shortened by grasping the base of the blade, the lugs protecting the hand.

▼ MUNITION ARMOUR

Date c.1560
Origin Germany
Material Iron, leather

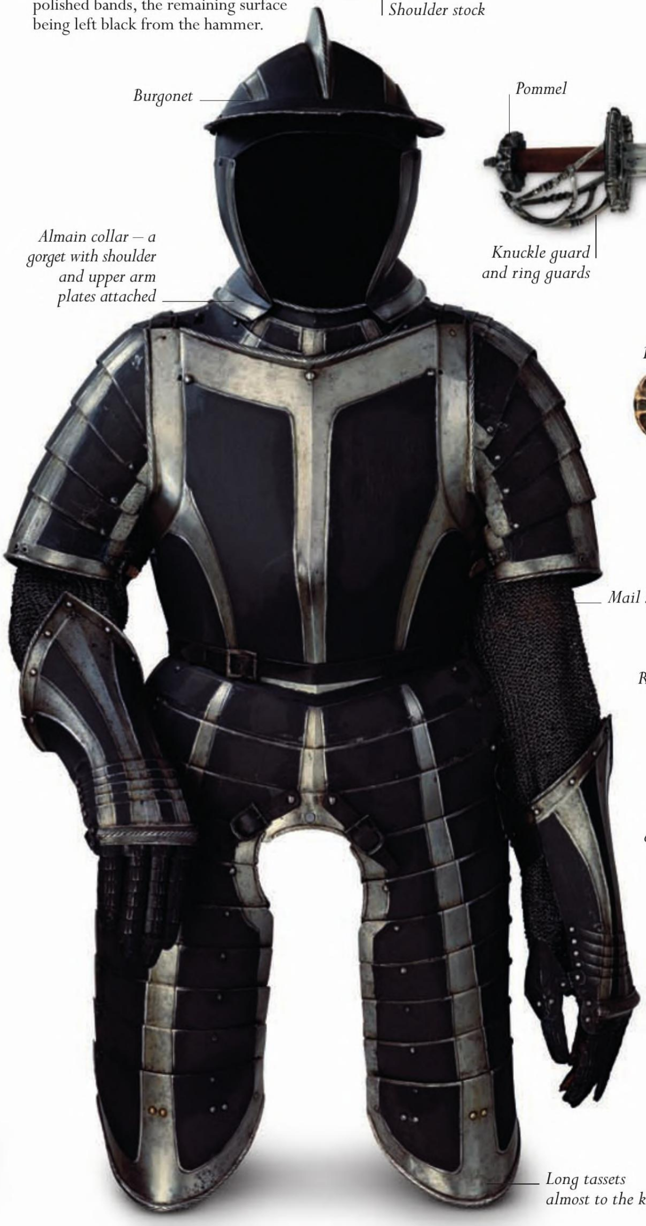
Infantry armours were a staple product of the German armour-producing centres. They were made in different configurations and qualities to suit the clients' needs. Many, such as this example, were decorated with polished bands, the remaining surface being left black from the hammer.

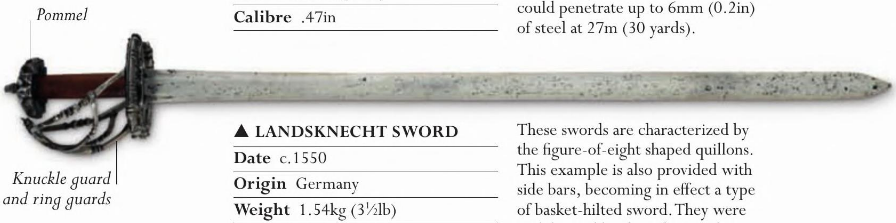

Tubular backsight
Snapping lock
Shoulder stock

▲ SNAPPING MATCHLOCK

Date c.1540
Origin Italy
Weight 3.5kg (7¾lb)
Barrel 1.05m (3½ft)
Calibre .47in

Henry VIII ordered 1,500 of these guns from the Venetian Republic in 1544. A year later, some of them were aboard his flagship, the *Mary Rose*, when it sank. Experiments with a modern replica showed that they could penetrate up to 6mm (0.2in) of steel at 27m (30 yards).

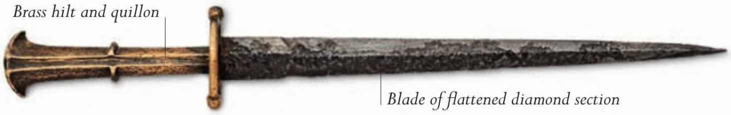

Burgonet
Almain collar – a gorget with shoulder and upper arm plates attached
Mail sleeves
Long tassets almost to the knees


Pommel
Knuckle guard and ring guards

▲ LANDSKNECHT SWORD

Date c.1550
Origin Germany
Weight 1.54kg (3½lb)
Length 96cm (37¾in)

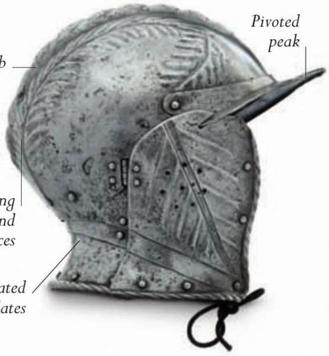
These swords are characterized by the figure-of-eight shaped quillons. This example is also provided with side bars, becoming in effect a type of basket-hilted sword. They were widely used by the infantry of Germany and northern Italy.


Brass hilt and quillon
Blade of flattened diamond section

▲ LANDSKNECHT DAGGER

Date c.1520
Origin Germany
Weight 330g (11¼oz)
Length 31cm (12¼in)

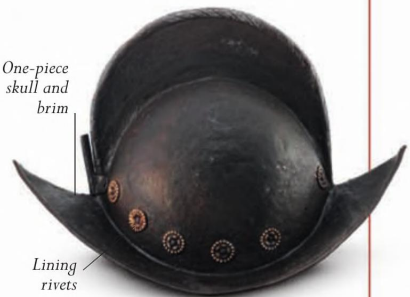
These simple weapons, in use over much of Europe, were invaluable in hand-to-hand fighting. Most had double-edged blades with a flattened diamond-shape in cross-section. Blades were to become slimmer as the century progressed.


Pivoted peak
Roped comb
Embossing on skull and cheekpieces
Articulated gorget plates

◀ BURGONET

Date c.1570
Origin Germany
Material Iron, leather

This burgonet with its roped comb and embossed leaf decoration must have formed part of a superior armour. It differs from those of munition quality in having articulating lames for the rear gorget plate and a pivoted peak or fall.


One-piece skull and brim
Lining rivets

▶ COMB MORION

Date c.1580
Origin Italy
Material Iron, leather

The comb morion eventually developed into the pikeman's pot. Early examples have the comb, skull, and brim forged in one piece, while later examples were made in two halves. The earpieces on this example are missing.

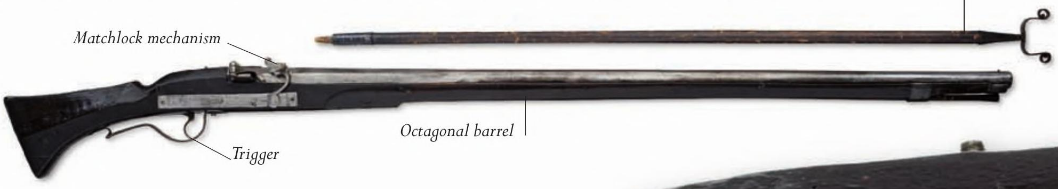
SIMPLE BUT EFFECTIVE FIREARM

MATCHLOCK MUSKET

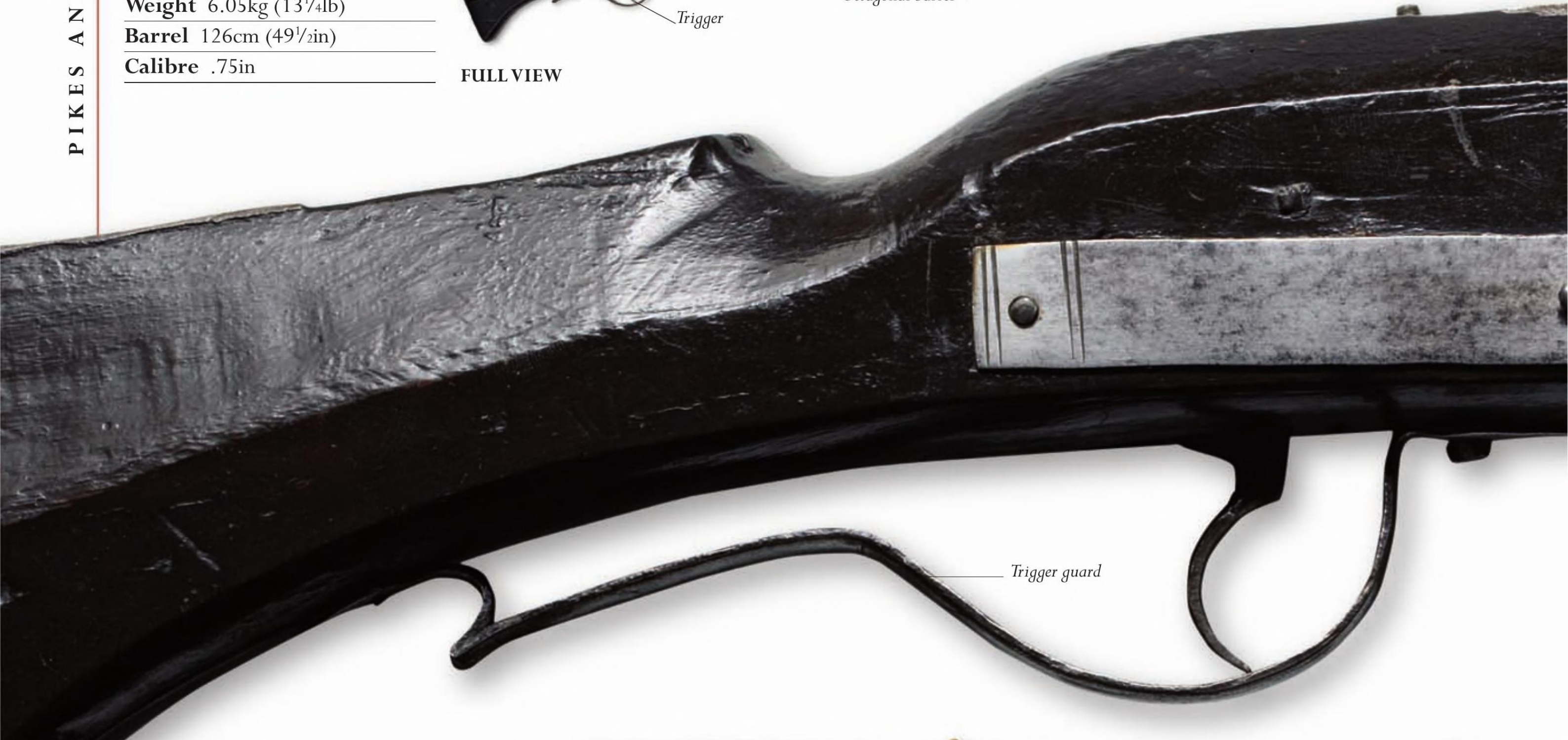
The invention of the matchlock *hackenbüsche*, or arquebus, cannot be dated precisely, but evidence points to it being around 1475, of German origin. Its source of ignition was a length of smouldering "match" – cord soaked in saltpetre. On pulling the trigger, the match, held in a pivoting holder, swung down and touched off a small quantity of priming powder held in a pan, which lit the main gunpowder charge via a narrow touch-hole. Matchlocks were superseded by flintlocks in the early 1600s, but were still used until the end of that century, due to their simplicity and low cost.

▶ MATCHLOCK MUSKET

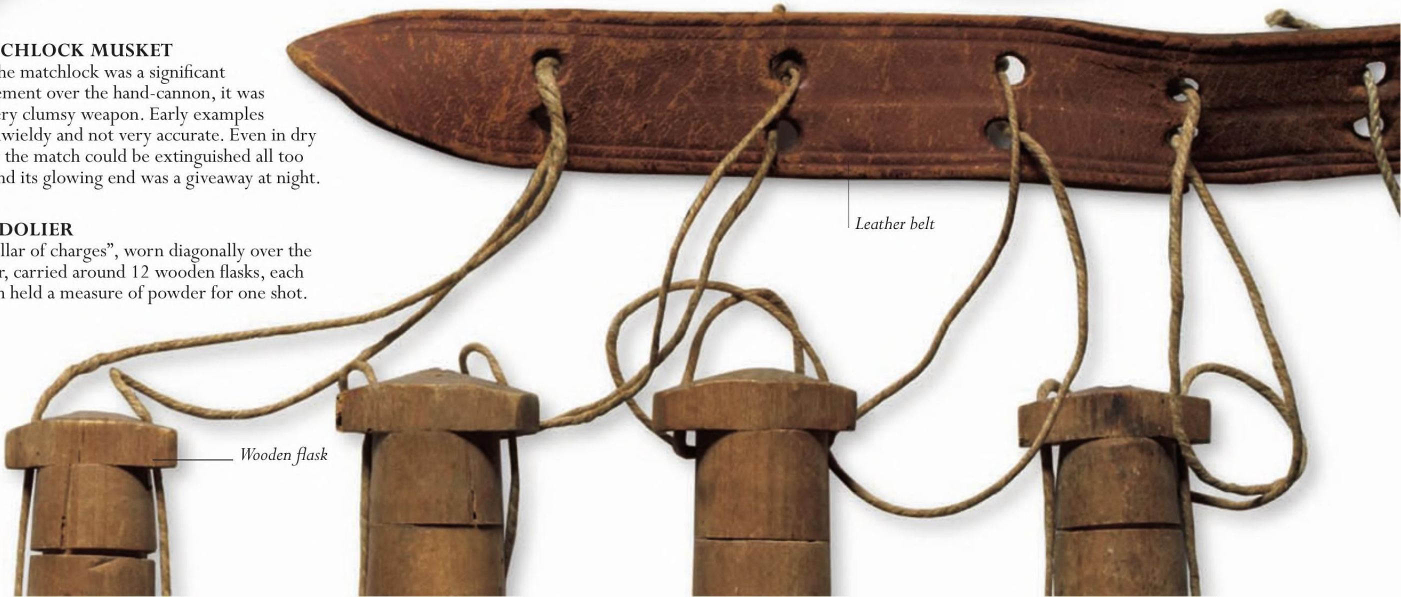
Date	Mid-17th century
Origin	Britain
Weight	6.05kg (13¼lb)
Barrel	126cm (49½in)
Calibre	.75in



FULL VIEW



▲ MATCHLOCK MUSKET
While the matchlock was a significant improvement over the hand-cannon, it was still a very clumsy weapon. Early examples were unwieldy and not very accurate. Even in dry weather the match could be extinguished all too easily, and its glowing end was a giveaway at night.

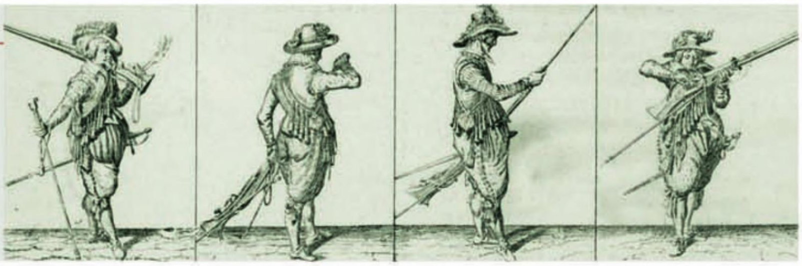


▶ BANDOLIER
This "collar of charges", worn diagonally over the shoulder, carried around 12 wooden flasks, each of which held a measure of powder for one shot.

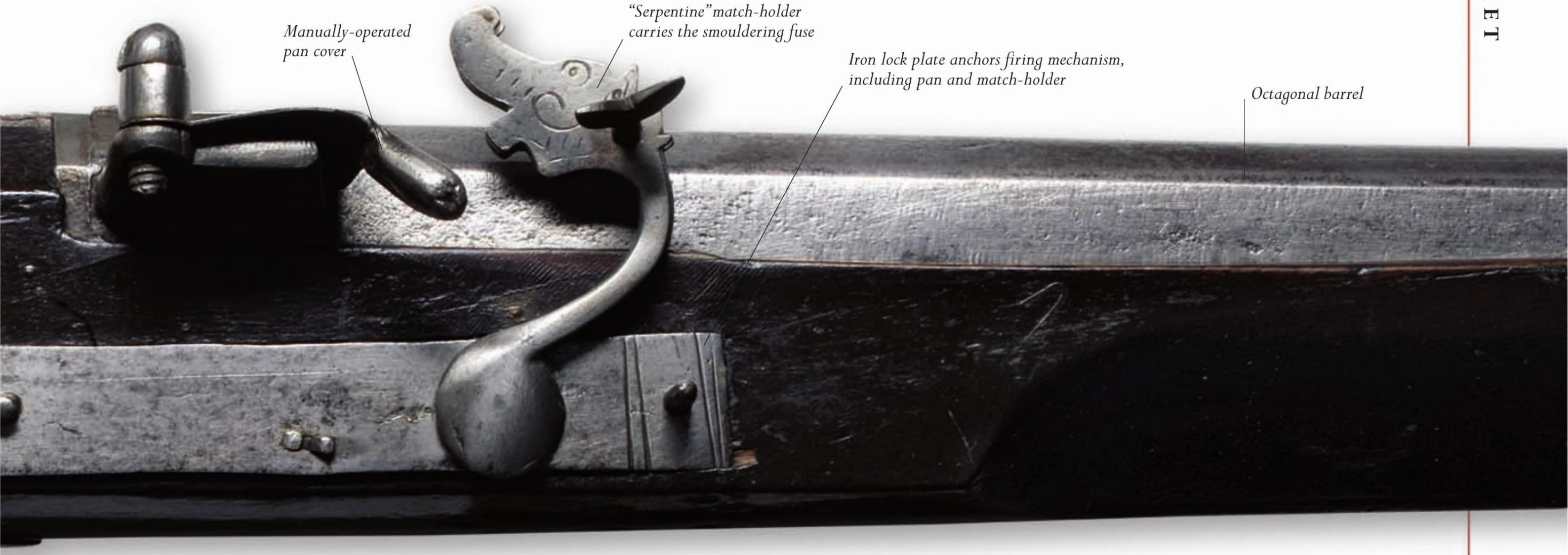
IN ACTION

MATCHLOCK DRILL

In the first of these pictures from a Dutch drill manual, the match in the musketeer's left hand is already lit. In the second, he pours gunpowder from a flask on his bandolier. He then rams down a musket ball, before preparing to pour priming powder into the pan from a priming flask, keeping the smouldering match at a safe distance in his left hand.

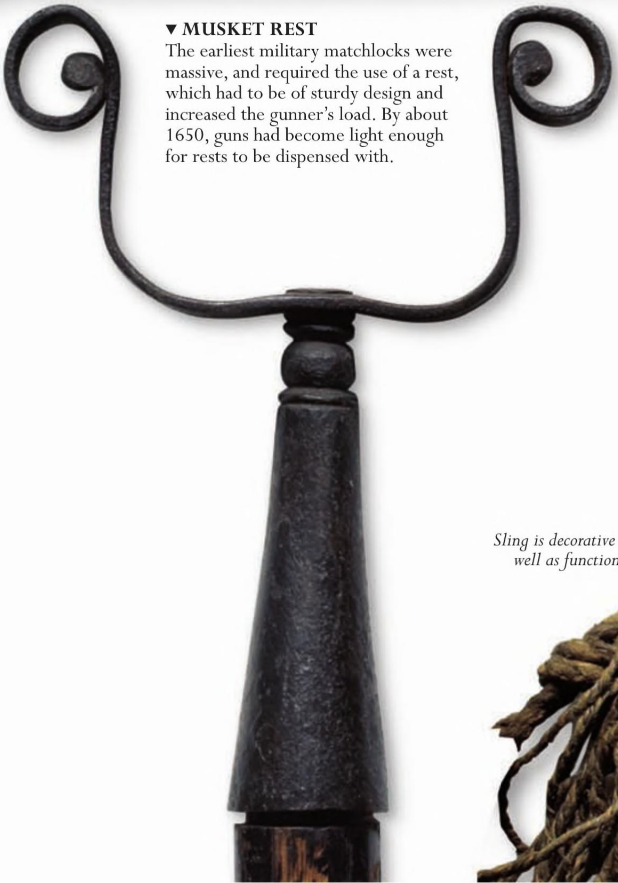


▶ Good dexterity was required to load matchlocks in the field.


Manually-operated pan cover
"Serpentine" match-holder carries the smouldering fuse
Iron lock plate anchors firing mechanism, including pan and match-holder
Octagonal barrel

▼ MUSKET REST

The earliest military matchlocks were massive, and required the use of a rest, which had to be of sturdy design and increased the gunner's load. By about 1650, guns had become light enough for rests to be dispensed with.

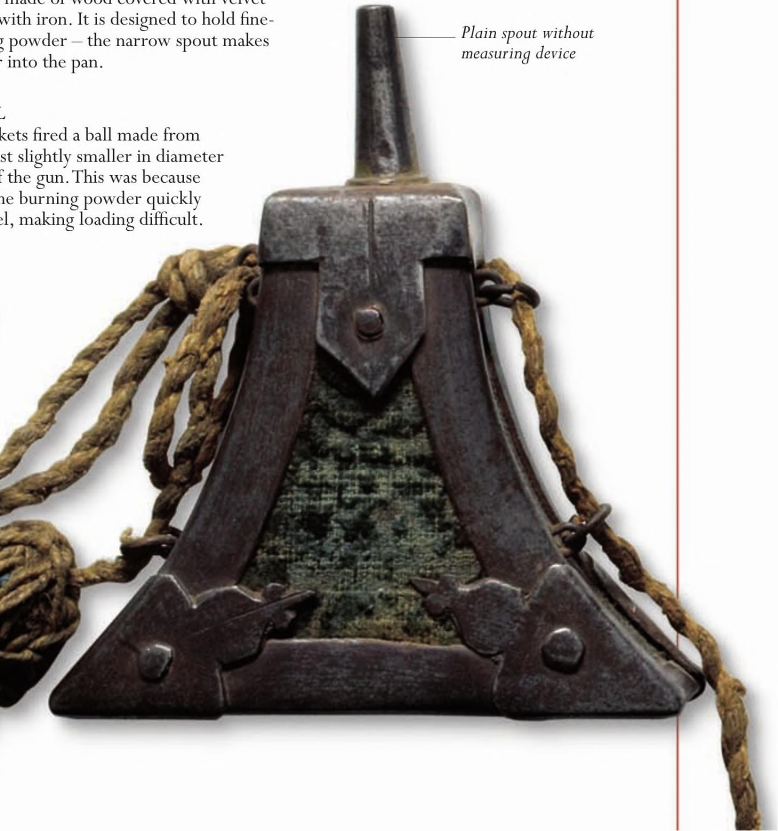


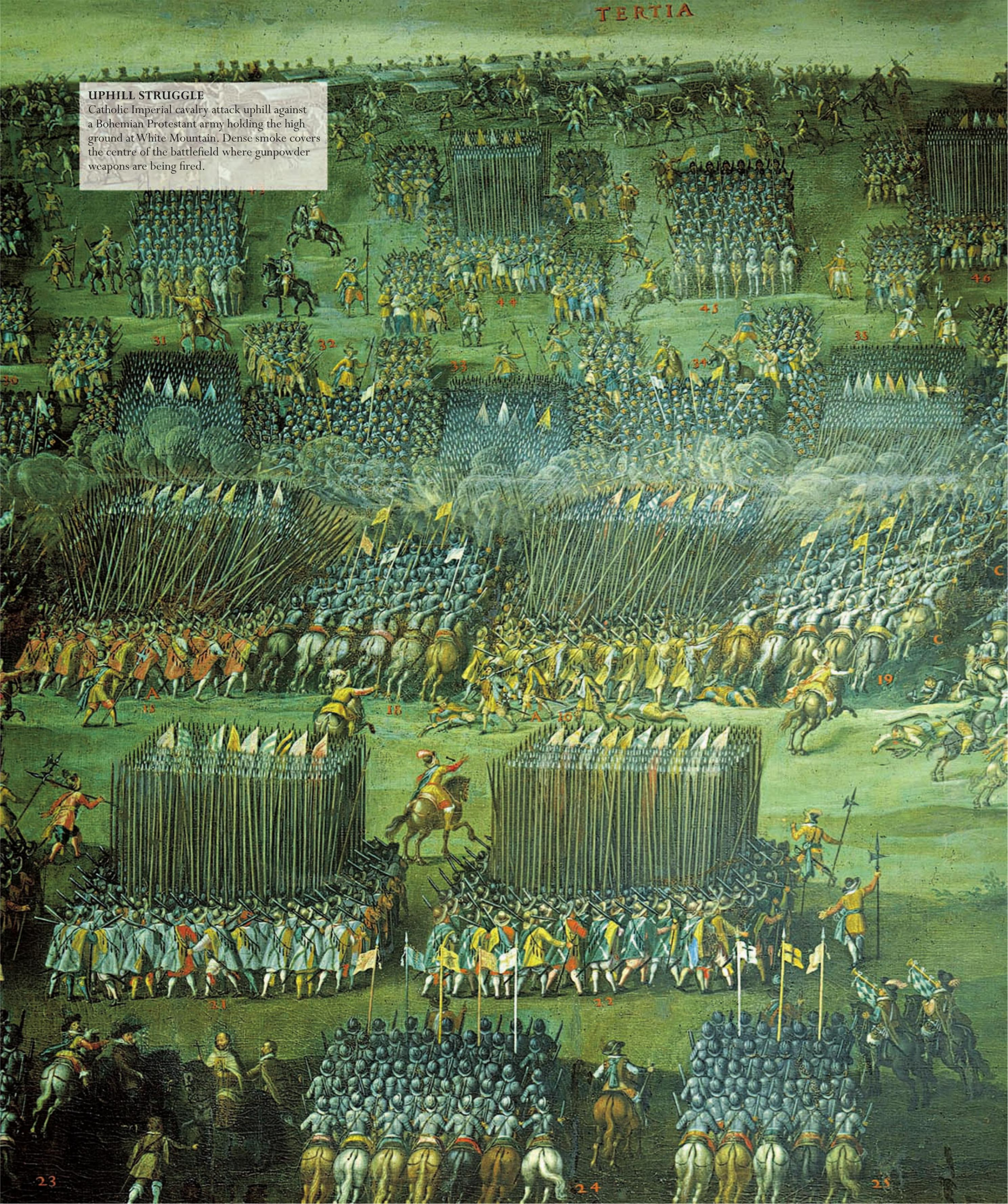
▶ POWDER FLASK

This example is made of wood covered with velvet and reinforced with iron. It is designed to hold fine-grained priming powder – the narrow spout makes it easier to pour into the pan.

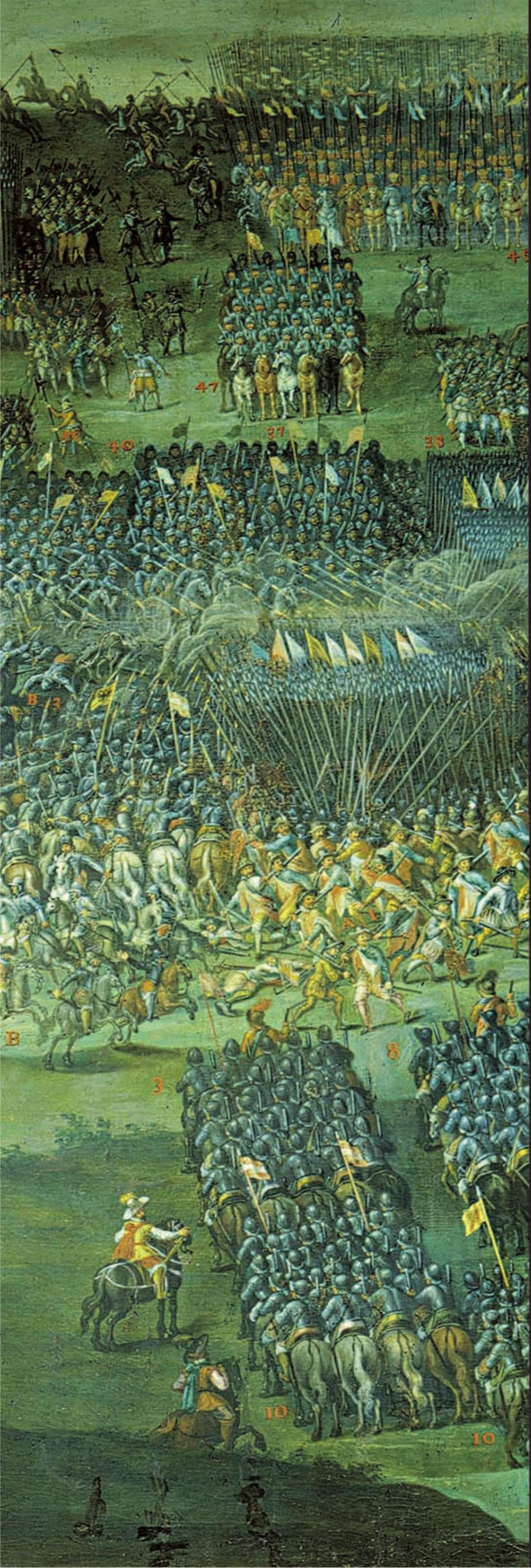
▼ LEAD BALL

Matchlock muskets fired a ball made from lead that was cast slightly smaller in diameter than the bore of the gun. This was because residues from the burning powder quickly fouled the barrel, making loading difficult.


Plain spout without measuring device
Sling is decorative as well as functional


TERTIA
31
32
33
34
35
44
45
46
30
A
18
A
20
19
C
C
21
22
23
24
25

UPHILL STRUGGLE
Catholic Imperial cavalry attack uphill against a Bohemian Protestant army holding the high ground at White Mountain. Dense smoke covers the centre of the battlefield where gunpowder weapons are being fired.



PIKE AND MATCHLOCK MUSKET

THE BATTLE OF WHITE MOUNTAIN

In the Thirty Years' War, fought in central Europe between 1618 and 1648, all armies used infantry armed with pikes and matchlock muskets. This distinctive form of warfare is exemplified by the Battle of White Mountain, an important encounter in the opening phase of the conflict.

The Battle of White Mountain was fought outside Prague on 8 November 1620, when Bohemian Protestants, rebelling against the authority of the Holy Roman Emperor, were confronted by a mix of Catholic Imperial forces. Both armies numbered between 20,000 and 30,000 men – quite substantial amounts by the standard of the time. Commanded by Christian of Anhalt, the Bohemian Protestants had taken an advantageous defensive position on high ground, but the Catholics, led by Johann Tserclaes, Count von Tilly, were more experienced and enjoyed superior morale.

PIKE SQUARES

On both sides the pikemen formed up in tightly packed squares, a practice that had been commonplace in European warfare for over a century. The smaller number of infantry equipped with firearms – predominantly matchlock muskets – were either positioned in a "sleeve" around the outside of the pike square, or formed into squads known as "horns" at the four corners of each square. Influenced by recent tactical developments initiated by the Dutch, the Protestants deployed their pikemen in shallower squares than the Catholics, with fewer lines from front to back. Like the infantry, the cavalry were deployed in tight formations. Each rider carried several wheellock pistols, pre-loaded in preparation for the battle. Their armour was less extensive and elaborate than that of a medieval knight, but the steel plate provided some protection, even against musket balls.

A SHORT ENGAGEMENT

The Protestants were first to take the offensive. The squares of pikemen advanced down the hill, directed by sergeants marching at the flanks with their halberds. Lowering their long, unwieldy weapons, the pikemen intended to engage the enemy infantry at close quarters with a "push of pike". The cavalry also came forward, riding knee-to-knee at a steady jog rather than a gallop. Following the established tactics of the time, each body of horsemen advanced towards an enemy pike square and discharged their pistols in a volley at as close a range as possible before turning away.

Count von Tilly, however, was confident in the quality of his troops and not inclined to stand on the defensive. He ordered his own cavalry and infantry aggressively up the slope. The Protestant musket troops were trained to fire in rolling volleys – the front row fired, then moved to the back to reload while the second row fired, and so on – to compensate for the slowness of reloading the matchlock, theoretically allowing a continuous fire to be maintained. But the Catholic squares advanced relentlessly forward through the thickening fog of gunpowder smoke, and their cavalry drove the Protestant horsemen into flight.

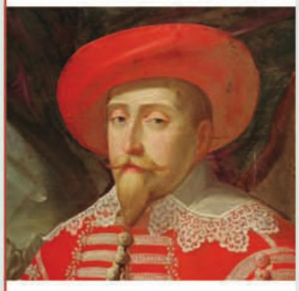
Unable to sustain an unsupported encounter with determined Catholic pikemen and pistol-armed cavalry at close range, the Protestants' pike squares began to break up and the pikemen were swiftly routed, fleeing for their lives. Almost 5,000 men were killed in the battle – a victory for the Catholics that was completed in less than two hours.

KEY **FIGURE**

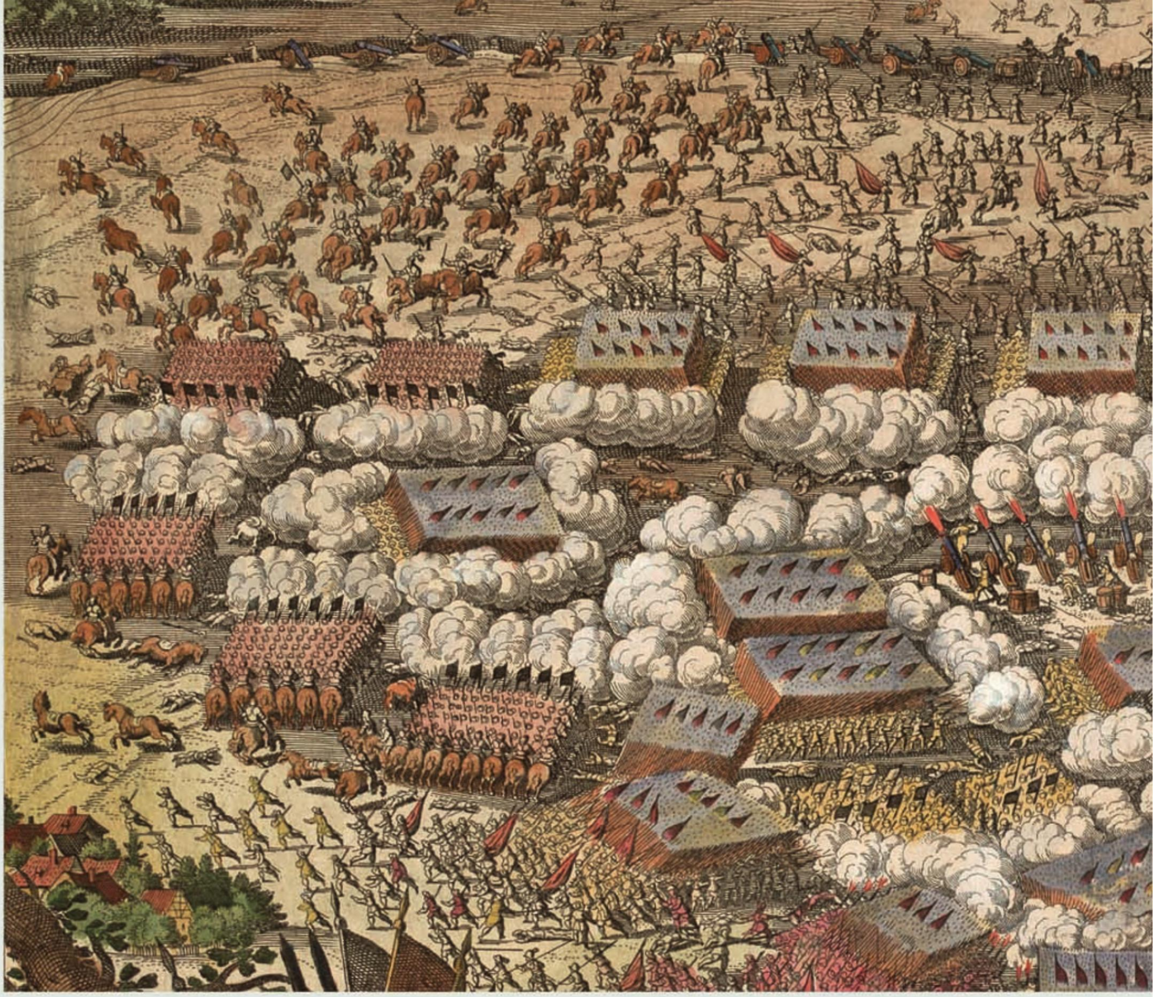
GUSTAVUS ADOLPHUS

1594–1632

King Gustav II Adolf of Sweden, known as Gustavus Adolphus, was an innovative tactician who emphasized the central battlefield role of the cavalry charge. From 1630, he intervened in the Thirty Years' War in Germany. Initially victorious, he later died in battle at Lützen, in 1632.



▲ Proud and aggressive, Gustavus Adolphus was dubbed "The Lion of the North".

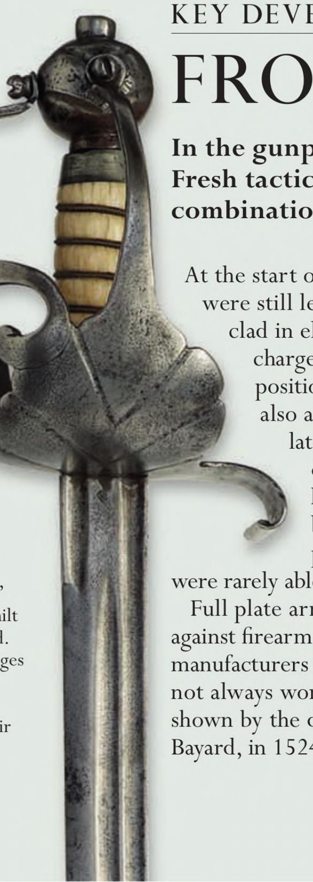


▶ **CAVALRY AND ARTILLERY**
The Battle of First Breitenfeld, in 1631, was a triumph for King Gustavus Adolphus of Sweden. It showed how effective cavalry could be when used alongside pike-and-musket infantry and artillery.

KEY DEVELOPMENT

FROM LANCE TO PISTOL

In the gunpowder age, cavalry lost their dominance on the battlefields of Europe. Fresh tactics had to be invented to restore a vital role to cavalry, working in combination with infantry and artillery.



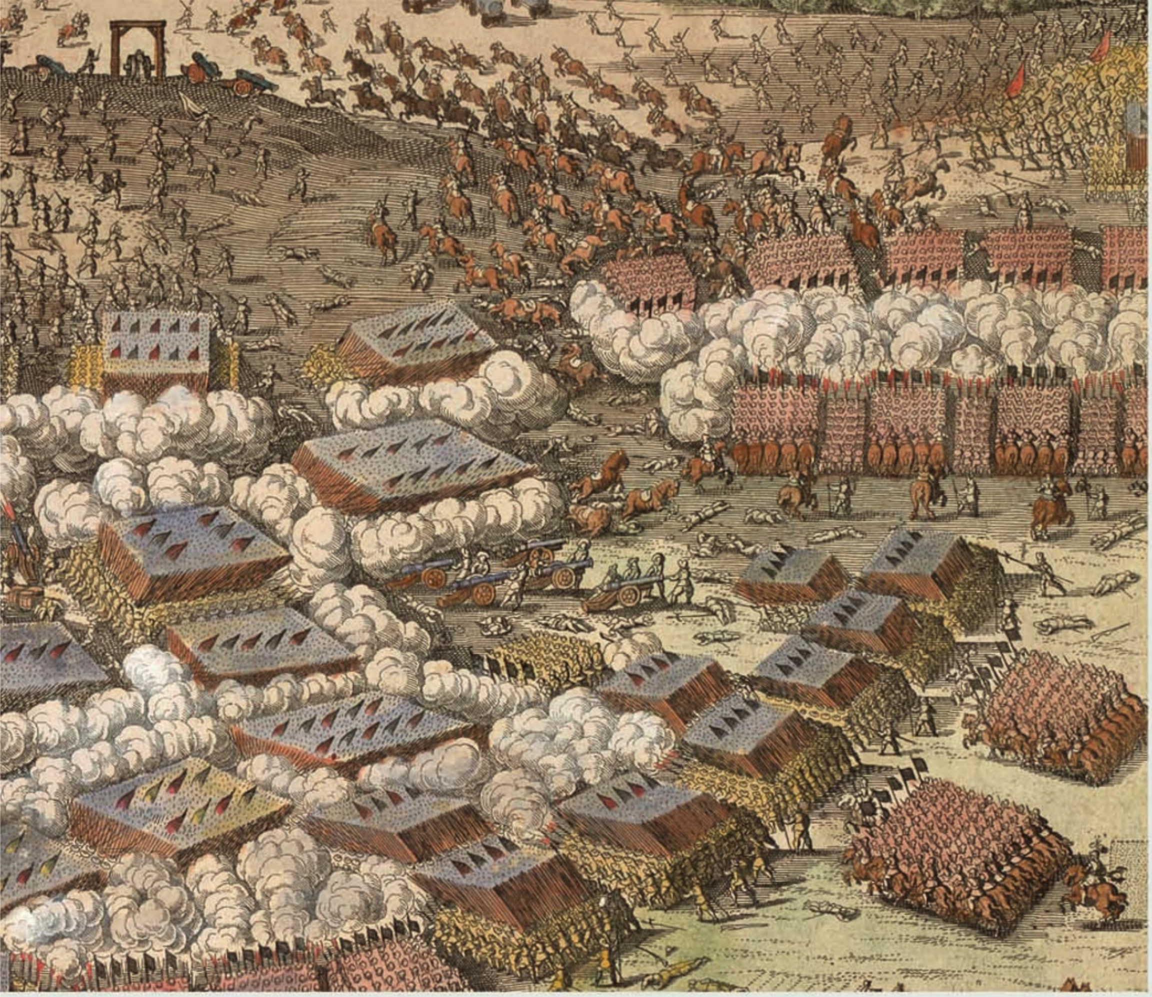
▶ **PROTO-MORTUARY-SWORD**
Unique to Britain, "mortuary-swords" had a barred iron hilt to protect the hand. Some featured images of King Charles I after his execution in 1649, hence their modern name.

At the start of the 16th century, European armies were still led by bodies of chivalrous knights, clad in elaborate armour, and employing the charge with couched lance (in the attacking position). Traditions such as jousting were also at the height of their popularity – as late as 1559, King Henri II of France died after a lance splintered against his visor in a joust. On the battlefield, however, infantry often prevailed, and horsemen with lances were rarely able to break up formations of pikemen.

Full plate armour was supposed to protect against firearms – breastplates were tested by the manufacturers by firing a ball at them – but this did not always work in practice. Its limitations were shown by the death of the renowned Chevalier de Bayard, in 1524, whose armour could not save him when he was struck by an arquebus ball. The following year, the French aristocratic cavalry suffered at the hands of arquebusiers at the Battle of Pavia, in the Italian War. From the 1550s, however, heavier, bulletproof armour began to appear.

A NEW ERA

With infantry rising in status and the lance approaching obsolescence, new technology and tactics began to emerge. Mounted troops were unable to use matchlocks because these required two hands to operate, and they needed one hand to control their horses. However, the invention of the self-igniting wheellock allowed cavalry to use pistols. In the 1540s, the Reiters, German mounted mercenaries, adopted firearms and reduced their armour to a helmet, cuirass, and arm defence. For use against pike squares, they invented the "caracole"



KEY **EVENTS**

1500–1650

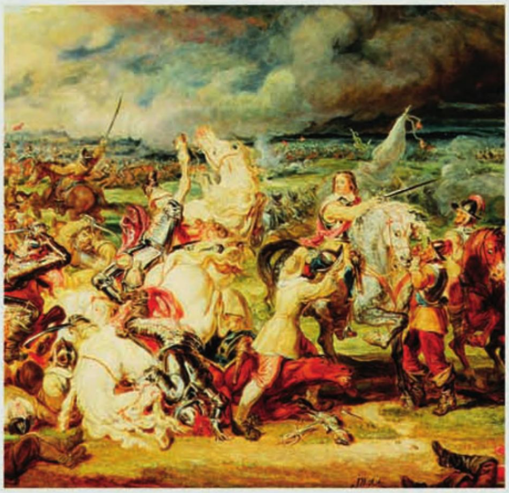
- **1515** King François I of France wins the Battle of Marignano, with a charge by fully armoured horsemen with couched lance.
- **c.1540** German cavalry, the Reiters, adopt the wheel-lock pistol as their main armament.
- **1562** Cavalry use the "caracole" tactic at the Battle of Dreux, during the French Wars of Religion.
- **1590** At the Battle of Ivry, Henry of Navarre triumphs using a cavalry charge with pistol and sword.
- **c.1600** European armies introduce dragoons – horsemen who fought dismounted with carbines (shorter muskets).
- **1610** Polish hussars defeat the Russians and Swedes at the battle of Klushino.
- **1630** In the Thirty Years' War, the Swedish combine cavalry with other arms.
- **1640s** In the English Civil Wars, Oliver Cromwell's Ironside cavalry fights in a disciplined close formation.

– a manoeuvre in which the horseman turned his horse to one side and then the other, enabling him to discharge a pistol to the left and right. The pistoleers rode at the pikemen in a column and fired at close range, each rank firing a volley and then retreating to reload as another line took its turn.

By the start of the 17th century, European cavalry had largely abandoned the lance, and also the percussive weapons that had been essential against full armour, such as the war-hammer. A cavalryman's armament consisted of a sword and a firearm, or sometimes several preloaded pistols. Companies of dragoons rode to the battlefield, but fought unmounted with firearms, like musketeers. Commanders were, however, unwilling to abandon the cavalry charge: it was seen as glamorous, and could still be decisive in battle.

In the hands of leaders such as King Gustavus Adolphus of Sweden, cavalry recovered its shock effect. Deployed on the flanks of infantry, horsemen would first charge the opposing cavalry. Then, after discharging their firearms, they would attack with swords drawn; breaking through the lines would allow them to overrun enemy cannon. Bodies of musketeers augmented the mounted firepower, combining to drive the opponent's cavalry from the field, exposing enemy infantry to attack.

> "God made them as **stubble to our swords**. We charged their regiments of foot with our horse, and **routed all** we charged"
>
> **OLIVER CROMWELL**, WRITTEN AFTER THE BATTLE OF MARSTON MOOR, 1644



◀ **CAVALRY CHARGE**
The English Civil War battle at Marston Moor, in July 1644, was won by the Parliamentarians through the success of Oliver Cromwell's cavalry, the Ironsides. Their charge scattered the Royalist horses, leaving their infantry open to attack.

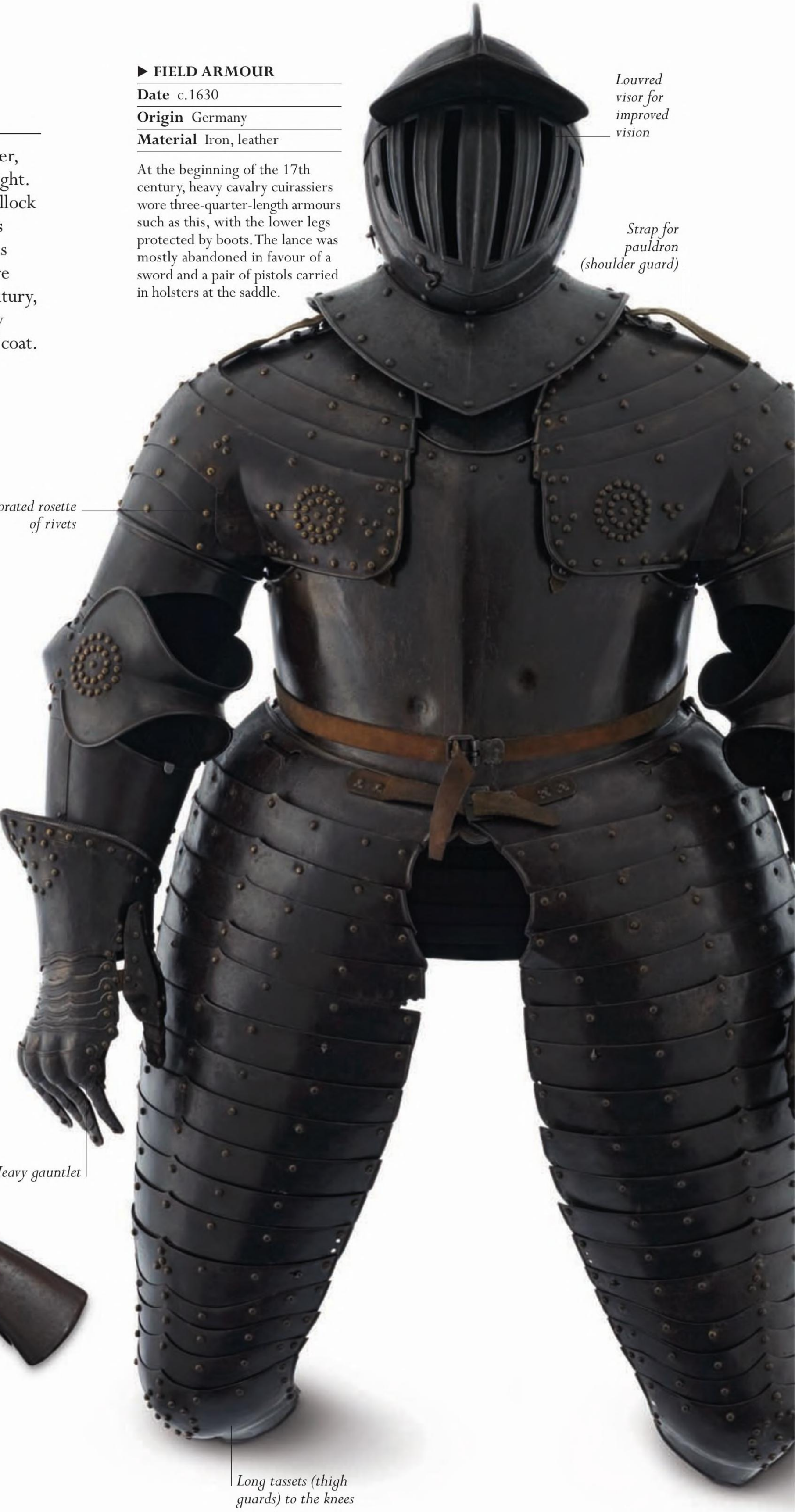
CAVALRY ARMOUR AND WEAPONS

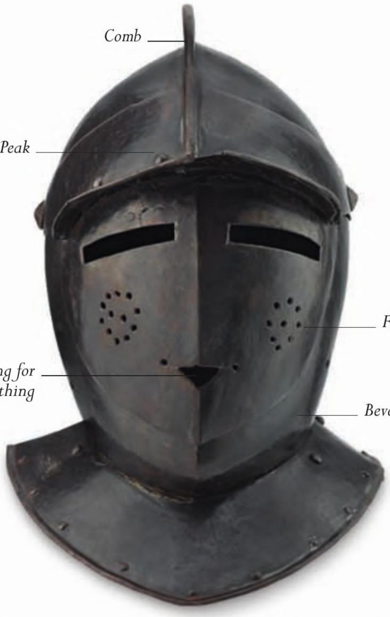
As firearms became more common, armour was made thicker, and its less important features were abandoned to reduce its weight. At the beginning of the 17th century, cavalry – armed with wheellock pistols and swords – still wore knee-length armour. New tactics such as the caracole, which involved successive ranks of riders discharging their pistols before riding to the rear to reload, were developed in order to defeat pikemen. By the middle of the century, most cavalry, now called harquebusiers due to the weapons they carried, wore only a heavy cuirass and an open helmet over a buff coat.

▶ FIELD ARMOUR

Date	c.1630
Origin	Germany
Material	Iron, leather

At the beginning of the 17th century, heavy cavalry cuirassiers wore three-quarter-length armours such as this, with the lower legs protected by boots. The lance was mostly abandoned in favour of a sword and a pair of pistols carried in holsters at the saddle.

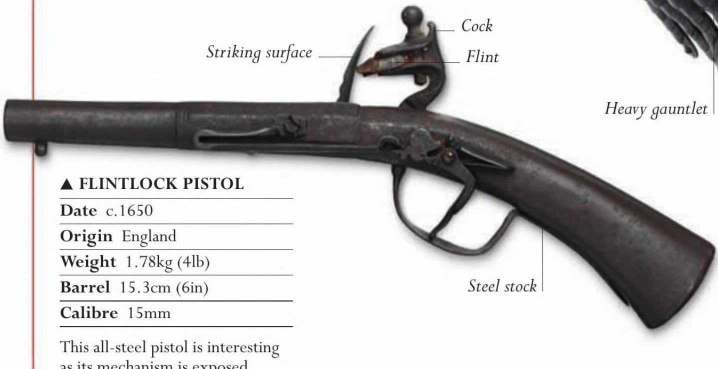

Louvred visor for improved vision
Strap for pauldron (shoulder guard)
Decorated rosette of rivets
Heavy gauntlet
Long tassets (thigh guards) to the knees


Comb
Peak
Face plate
Piercing for breathing
Bevor

▲ FLEMISH CUIRASSIER'S HELMET

Date	c.1600
Origin	Holland
Material	Iron, leather

Most helmets of this period were made in two halves that were joined along the comb. The bevor covering the chin and the peak pivoted at the same point. Attached to the peak was an almost flat plate covering the face; the plate was pierced for vision and breathing.


Cock
Striking surface
Flint
Steel stock

▲ FLINTLOCK PISTOL

Date	c.1650
Origin	England
Weight	1.78kg (4lb)
Barrel	15.3cm (6in)
Calibre	15mm

This all-steel pistol is interesting as its mechanism is exposed on the outside of the stock. A spring-loaded tumbler that runs through the stock governs the striking action of the cock when the trigger is pulled.

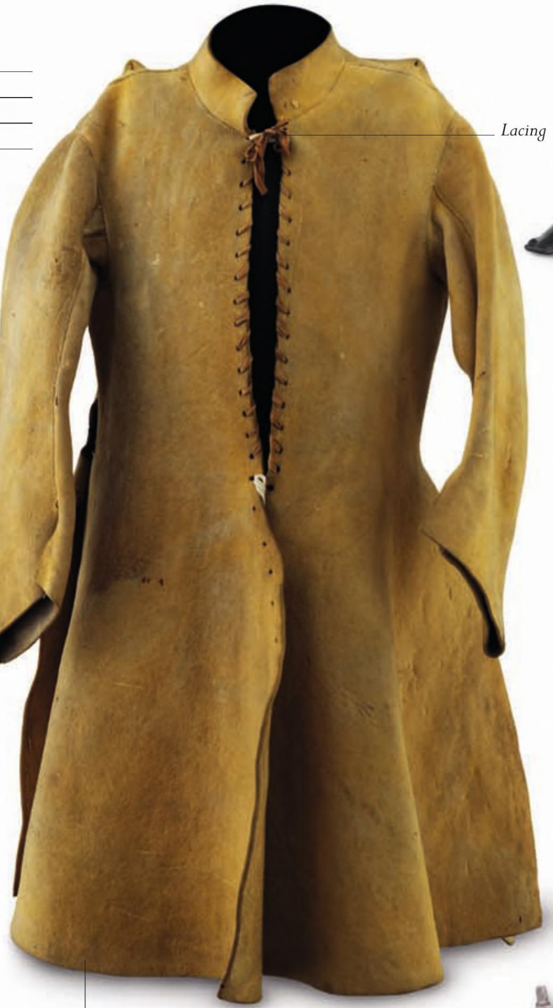
▶ BUFF COAT

Date c.1640

Origin England

Material Leather

These coats were made from cowhide about 3–4mm (¼in) thick. They provided fair protection from swords and long-range pistols. The lacing on this coat has been added for display: the original fastenings were hooks and eyes.


Lacing
Skirt split at the front and back for riding

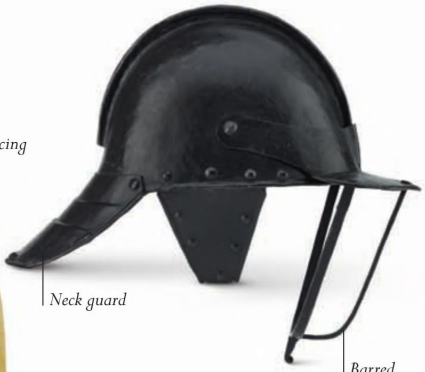
◀ TRIPLE-BARRED POT

Date c.1640

Origin England

Material Iron, leather

Troopers on both sides wore these simple helmets during the English Civil War. The two-piece skull is fitted with a neck guard – embossed to simulate lames – a pivoting peak with a barred face guard, cheekpieces, and a neck guard.


Neck guard
Barred face guard

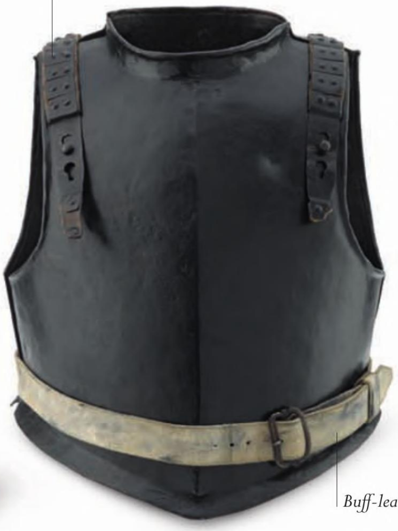
◀ HARQUEBUSIER'S CUIRASS

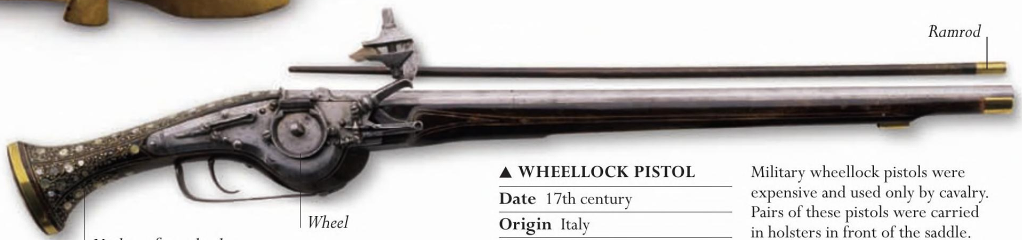
Date c.1640

Origin England

Material Iron, leather

This simple cuirass was worn over a buff coat. The breastplate was thick – sometimes double-layered – and bulletproof. The backplate was thinner, but robust enough to resist blade thrusts in close-combat skirmishes.


Riveted shoulder strap
Buff-leather belt

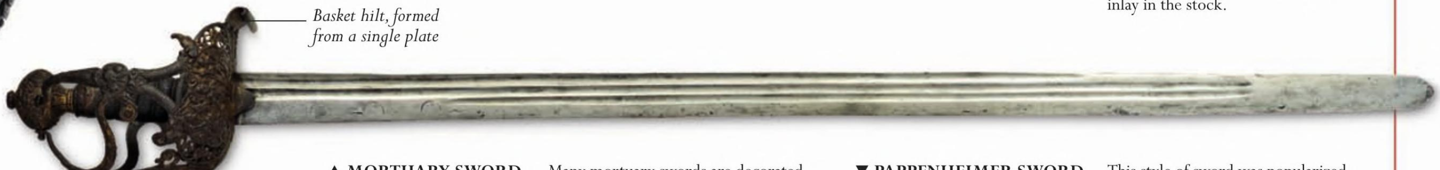

Ramrod
Wheel
Mother-of-pearl inlay

▲ WHEELLOCK PISTOL

Date 17th century

Origin Italy

Military wheellock pistols were expensive and used only by cavalry. Pairs of these pistols were carried in holsters in front of the saddle. This example is more decorative than most, having mother-of-pearl inlay in the stock.


Basket hilt, formed from a single plate

▲ MORTUARY SWORD

Date 1640

Origin England

Weight 0.89kg (2lb)

Length 92.1cm (36¼in)

Many mortuary swords are decorated with a chiselled portrait head amid foliage – the head supposedly of the executed King Charles I – giving the swords their name. They were used by both sides in the English Civil War.

▼ PAPPENHEIMER SWORD

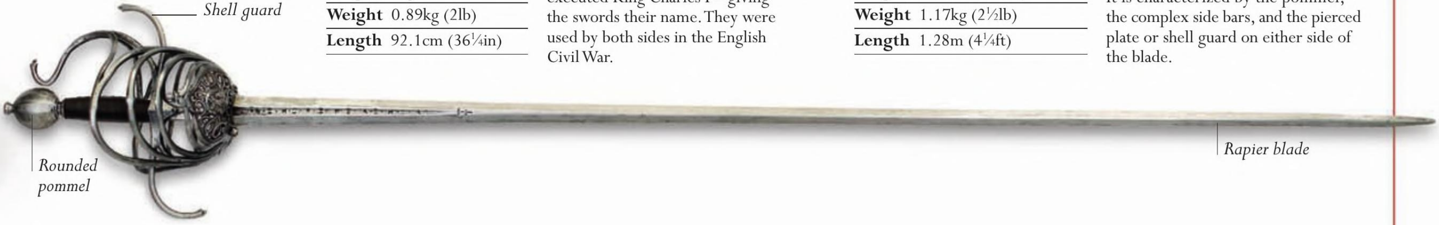
Date 1625–50

Origin Northern Europe

Weight 1.17kg (2½lb)

Length 1.28m (4¼ft)

This style of sword was popularized by Count Pappenheim, a Bavarian field marshal in the Thirty Years' War. It is characterized by the pommel, the complex side bars, and the pierced plate or shell guard on either side of the blade.


Shell guard
Rounded pommel
Rapier blade

KEY DEVELOPMENT

THE ISLAMIC EMPIRES AT WAR

The Muslim empires of the Ottomans, Mughals, and Safavids ruled a large swathe of Eurasia in the 16th and 17th centuries. Their armies combined Asian tribal heritage, reflected in the importance of horsemen, with gunpowder weapons.

The Mughals originated from Central Asia. Led by Zahir-ud-Din Babur, they conquered Afghanistan and northern India in the early 16th century, founding the Mughal Empire. Under Babur's successors, Mughal rule extended over the Indian subcontinent through near-constant campaigning.

The Mughal emperors recruited nomadic tribesmen from Central Asia, who fought as light horsemen with powerful composite bows. The army also absorbed the forces of conquered Indian states such as the Rajputs – aristocratic Hindu warriors armed with swords and daggers. Other Indian nobles supplied peasant infantry from their lands.

Mughal foot soldiers carried matchlock muskets, made by imitating foreign models; they also used brass and bronze cannon. In battle, musket- or spear-armed infantry lined up alongside field guns to form a block in front of the commanders, who sat on elephants that served as mobile command posts. Light horsemen on the flanks rode forward to shower the enemy with arrows, before the armoured cavalry in the centre charged with mace, sword, and lance. Their engineers built roads and mined under walls during sieges. Their main weakness was their infantry, a low-status, undisciplined rabble.

THE OTTOMANS

The Ottoman Turks were originally from Central Asia but, by 1500, they had ruled most of Turkey and the Balkans for over 100 years. In the 16th century, they extended their empire into Hungary, west Asia to the Persian border, Egypt, and North Africa.

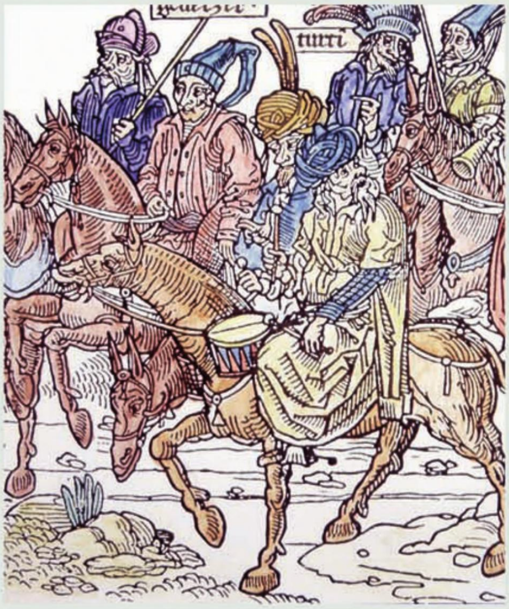
The Ottoman army comprised infantry, cavalry, and artillery. Their elite infantry were Janissaries, seized as children from Christian families in the Balkans and raised as Muslim slaves. They carried firearms, and formed a disciplined corps of musket troops as part of the sultan's household guard. The household troops also featured a core of cavalry, the *sipahis*, who served in return for the right to raise rent from land. With mail-and-plate armour, lances, javelins, and swords, they were supported by lighter horsemen with composite bows, known as *akinji*, who acted as scouts, raiders, and skirmishers. The power of Ottoman cannon was famous, and their artillery boasted almost 3,000 gunners by the late 16th century. Their navy, meanwhile, dominated the eastern Mediterranean.

THE SAFAFIDS

The Safavids came to power in Persia in 1501. At first, their army consisted of tribal horsemen, the Kizilbash. Lacking firearms, they were defeated by the Ottomans along the border of their two empires. But the Safavid monarch Shah Abbas (ruled 1587–1629), created a standing army that combined cavalry with musket-armed infantry and gunpowder artillery, drawing on European expertise. This more balanced force kept the Safavids in power until 1732.

> "I am the **sultan of sultans**, the sovereign of sovereigns, the **shadow of god** on earth"
>
> **SULEYMAN I**, IN A LETTER TO THE KING OF FRANCE, 1536

▲ **MUGHAL WAR ELEPHANT**
Elephants were widely used in Mughal armies. Commanders rode them into combat, and used them both as heavy cavalry and as vantage points from which to survey and direct the battle.



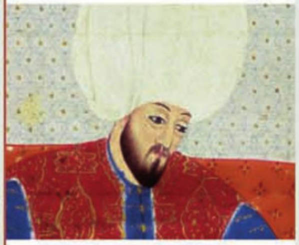
◀ **OTTOMAN JANISSARIES**
Elite Janissaries head for war on horseback to the beat of drums. Ottoman soldiers were noted for their good discipline and morale.

KEY **FIGURE**

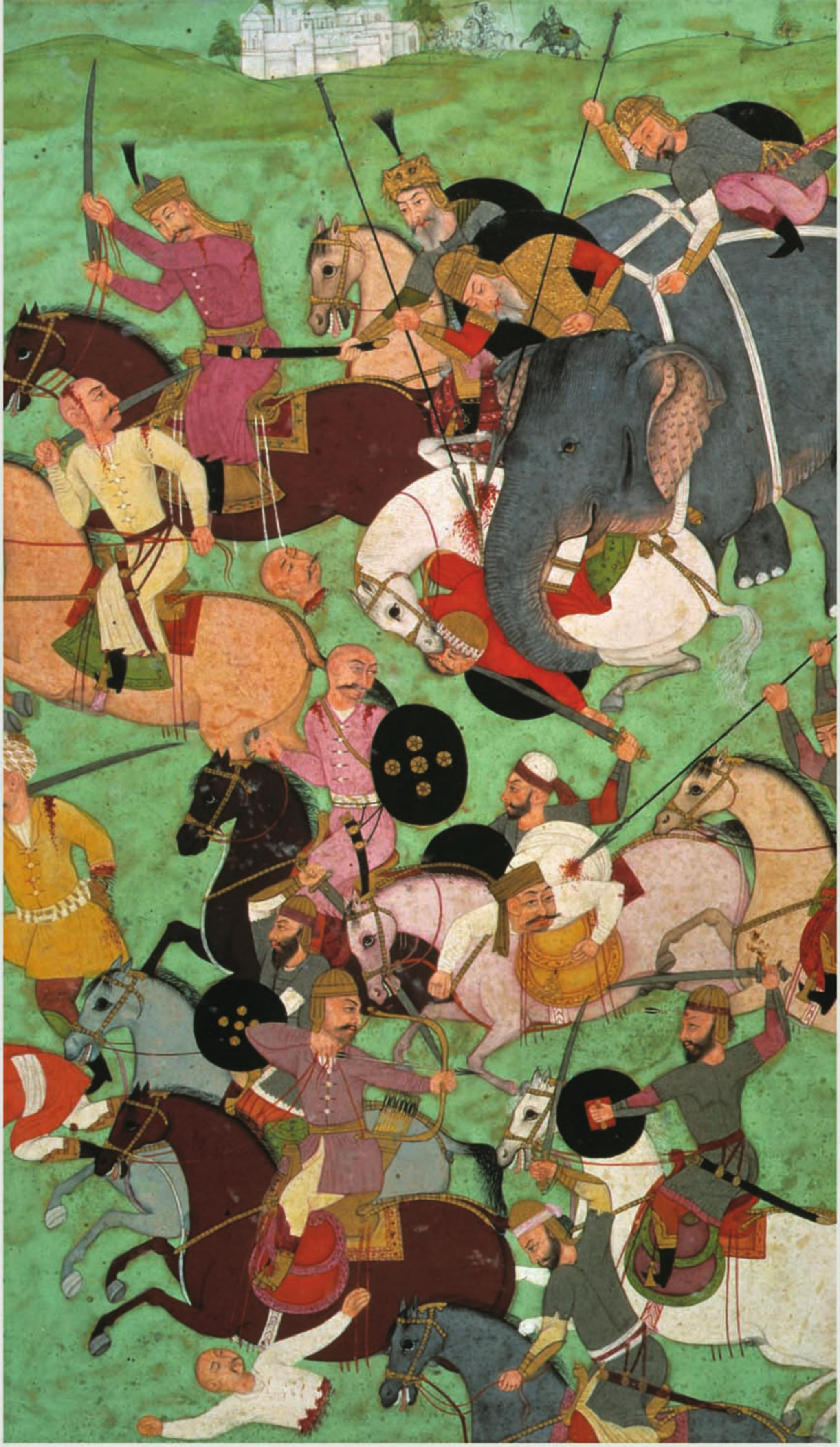
SULEYMAN I

1494–1566

Suleyman the Magnificent ruled the Ottoman Empire from 1520. He alternated campaigns in Europe with attacks on Safavid Persia, and his triumphs included the conquest of Hungary in 1526, and the capture of Baghdad in 1534. He failed, however, in a bid to take the island of Malta in 1565.



▲ In his younger years, Suleyman was an imposing figure, known for his chivalry as well as his valour. He later suffered from poor health.



◄ **MUGHAL CHARGE**
The armoured cavalry of Mughal ruler Akbar the Great charges its enemies in the 1560s, using swords and lances. Akbar was fond of war elephants, with 5,000 in his army, although they are reputed to have been panicked by gunpowder weapons.

KEY **EVENTS**

1500s–1700s

- **1514–17** Ottoman Turks defeat the Persian Safavids at Chaldiran, and the Egyptian Mamluks at Raydaniya, exploiting the use of gunpowder weapons against opponents who lack them.

- **1526** Led by Babur, the Mughals defeat the Sultan of Delhi at the battle of Panipat, their cannon terrifying the Sultan's force of war elephants.

- **1571** Ottoman war galleys, short of gunpowder weapons, are defeated by a Christian fleet at Lepanto (see pp.154–55).

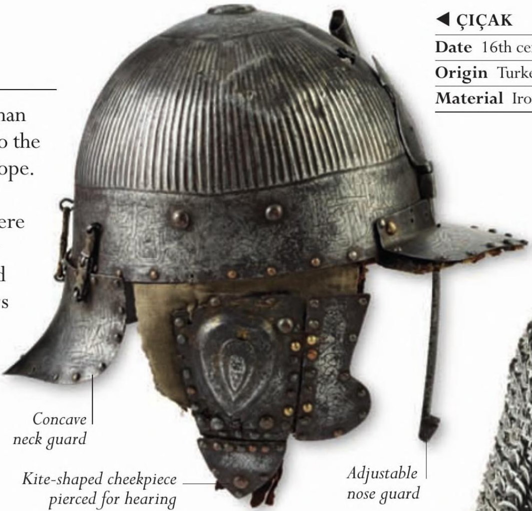
- **1587** In Persia, Shah Abbas I begins a successful modernization of the Safavid armed forces, employing European military experts.

- **1658–1707** The Mughal Empire reaches its greatest extent under the rule of Aurangzeb, gradually declining after his death.

- **1683** The Ottoman defeat at the Siege of Vienna marks the beginning of a sharp and irreversible decline in the success of the Ottoman army.

OTTOMAN ARMOUR AND WEAPONS

At its height, during the 16th century, the Ottoman Empire extended from modern-day Algeria in the west to the Caspian Sea in the east, pushing north into Central Europe. The Janissaries, a well-paid and well-equipped infantry corps, were credited with the empire's success. They were primarily archers, who later fought with guns and their characteristic swords (*yatagans*). The cavalry was divided into two groups: the *akinji*, the lightly armoured archers whose primary roles were reconnaissance and harrying of the enemy; and the *sipahis*, the heavy cavalry, who wore mail and plate and rode armoured horses, fighting with bows, lances, maces, and axes.


Concave neck guard
Kite-shaped cheekpiece pierced for hearing
Adjustable nose guard

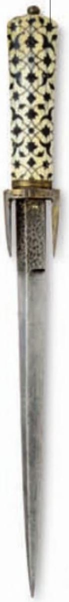
◀ ÇIÇAK

Date 16th century

Origin Turkey

Material Iron, textiles

Made with a one-piece skull, this helmet also had face, neck, and ear protection. The skull, earpieces, and peak still retain the quilted red fabric lining. The central band and neck guard are engraved with Koranic text.


Ivory hilt inlaid with arabesque pattern

◀ KHANJAR

Date c.1520

Origin Turkey

Weight 376g (13¼oz)

Length 39cm (15¼in)

The sturdy cross-section of the blade is designed for piercing mail. An area of unsharpened blade below the quillons allowed the soldier to grip closer to the quillons for greater control.

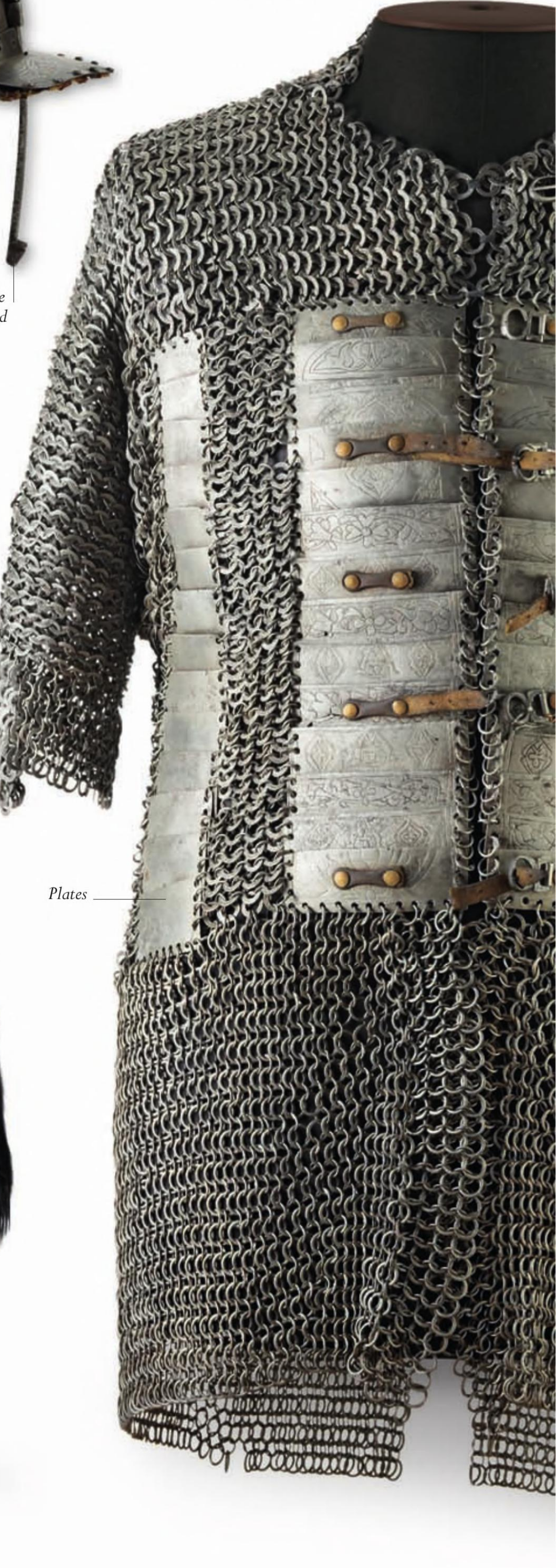
▶ ZIRH GOMLEK

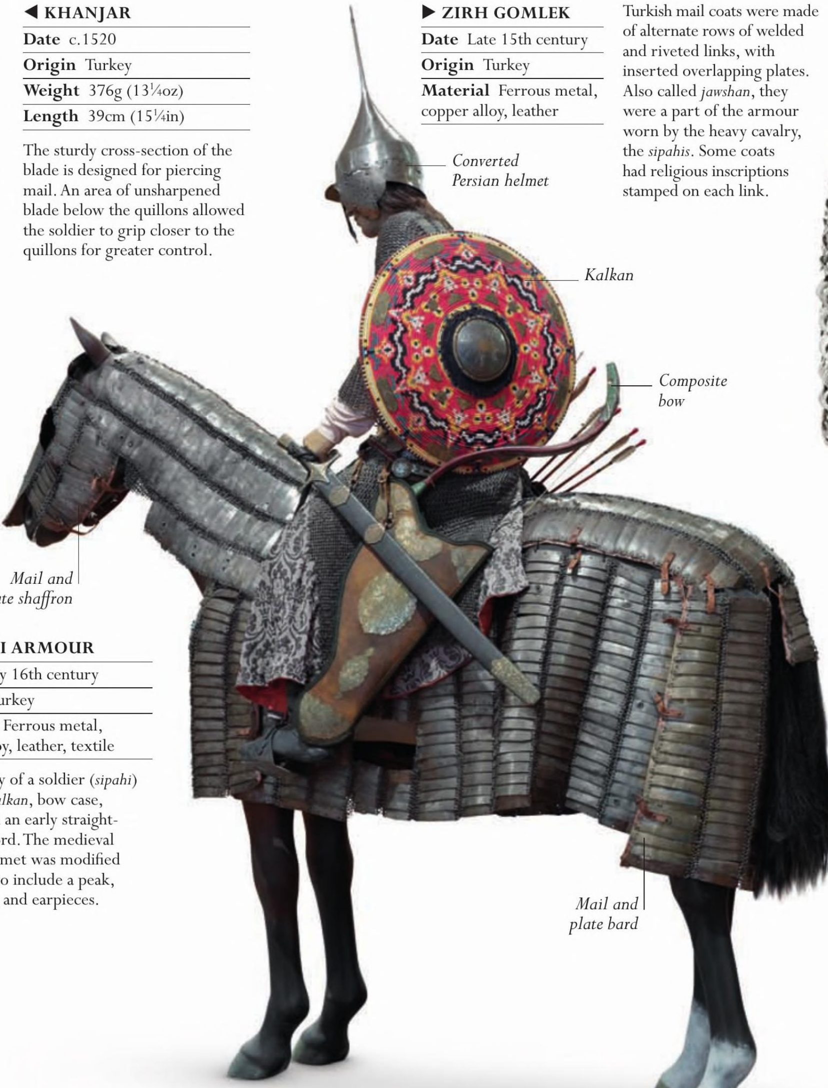
Date Late 15th century

Origin Turkey

Material Ferrous metal, copper alloy, leather

Turkish mail coats were made of alternate rows of welded and riveted links, with inserted overlapping plates. Also called *jawshan*, they were a part of the armour worn by the heavy cavalry, the *sipahis*. Some coats had religious inscriptions stamped on each link.




Converted Persian helmet
Kalkan
Composite bow
Mail and plate shaffron
Mail and plate bard

▶ SIPAHI ARMOUR

Date Early 16th century

Origin Turkey

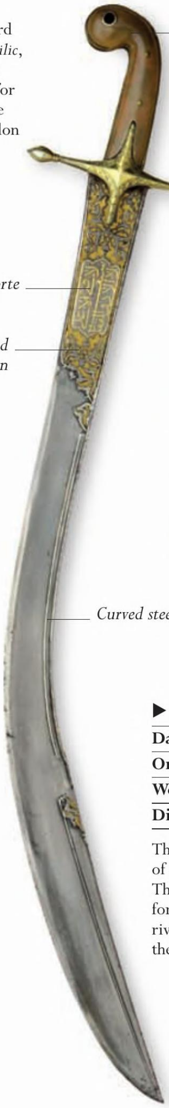
Material Ferrous metal, copper alloy, leather, textile

This display of a soldier (*sipahi*) carries a *kalkan*, bow case, quiver, and an early straight-bladed sword. The medieval Persian helmet was modified in Turkey to include a peak, a nasal bar, and earpieces.

▶ KILIC

Date	1625
Origin	Turkey
Weight	750g (26½oz)
Length	71cm (28in)

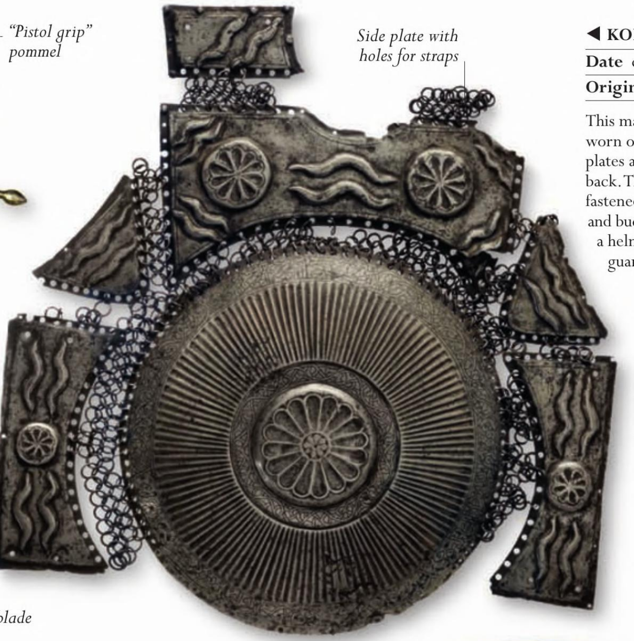
The characteristic sword of the Ottomans, the *kilic*, with its enlarged point section, was designed for slicing. The hilt is made of horn, while the quillon assembly is of gilded copper. The blade is chiselled and inlaid at the forte (the strong part of the blade).


"Pistol grip" pommel
Forte
Chiselled inlaid decoration
Curved steel blade

◀ KORAZIN

Date	c.1656
Origin	Turkey

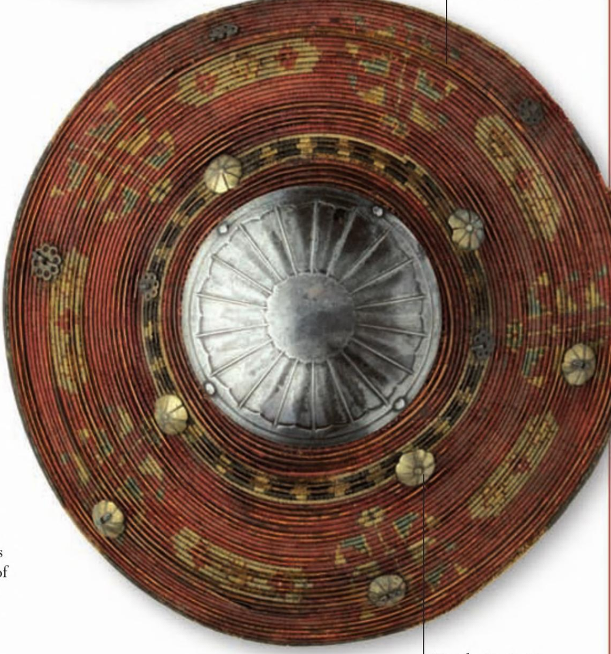
This mail and plate cuirass, worn over a mail coat, had plates around the neck and back. The front and back were fastened together with straps and buckles. It was worn with a helmet, tubular plate arm guards, and thigh guards.


Side plate with holes for straps

▶ KALKAN

Date	17th century
Origin	Turkey
Weight	1.9kg (4lb)
Diameter	52.5cm (20½in)

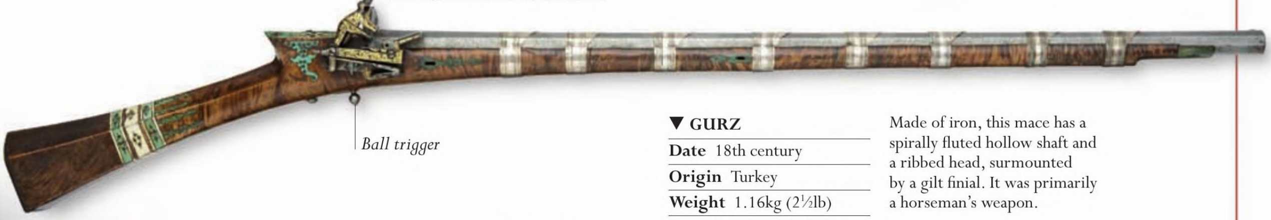
This shield is made from a spiral of cane with a central iron boss. The four inner rivets were for the handgrips; the six outer rivets were for straps that held the shield to the body.


Cane wrapped in coloured silks
Handgrip rivets

▼ MIQUELET RIFLE

Date	18th century
Origin	Turkey
Weight	2.39kg (5¼lb)
Barrel	78.5cm (31in)
Calibre	16mm

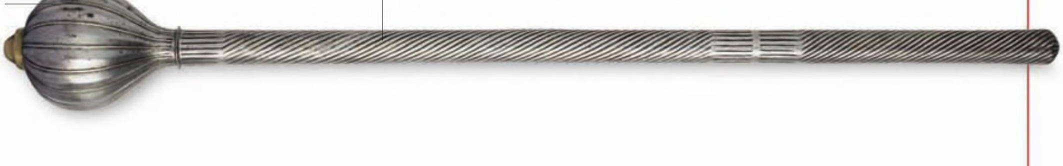
By the 17th century, the Ottoman army had adopted a version of the Mediterranean miquelet lock for its firearms. Most of these guns were of high quality, with rifled barrels and elaborately inlaid stocks. The lock and mounts of this example are lavishly decorated with gold inlay, while the barrel bands are silver.

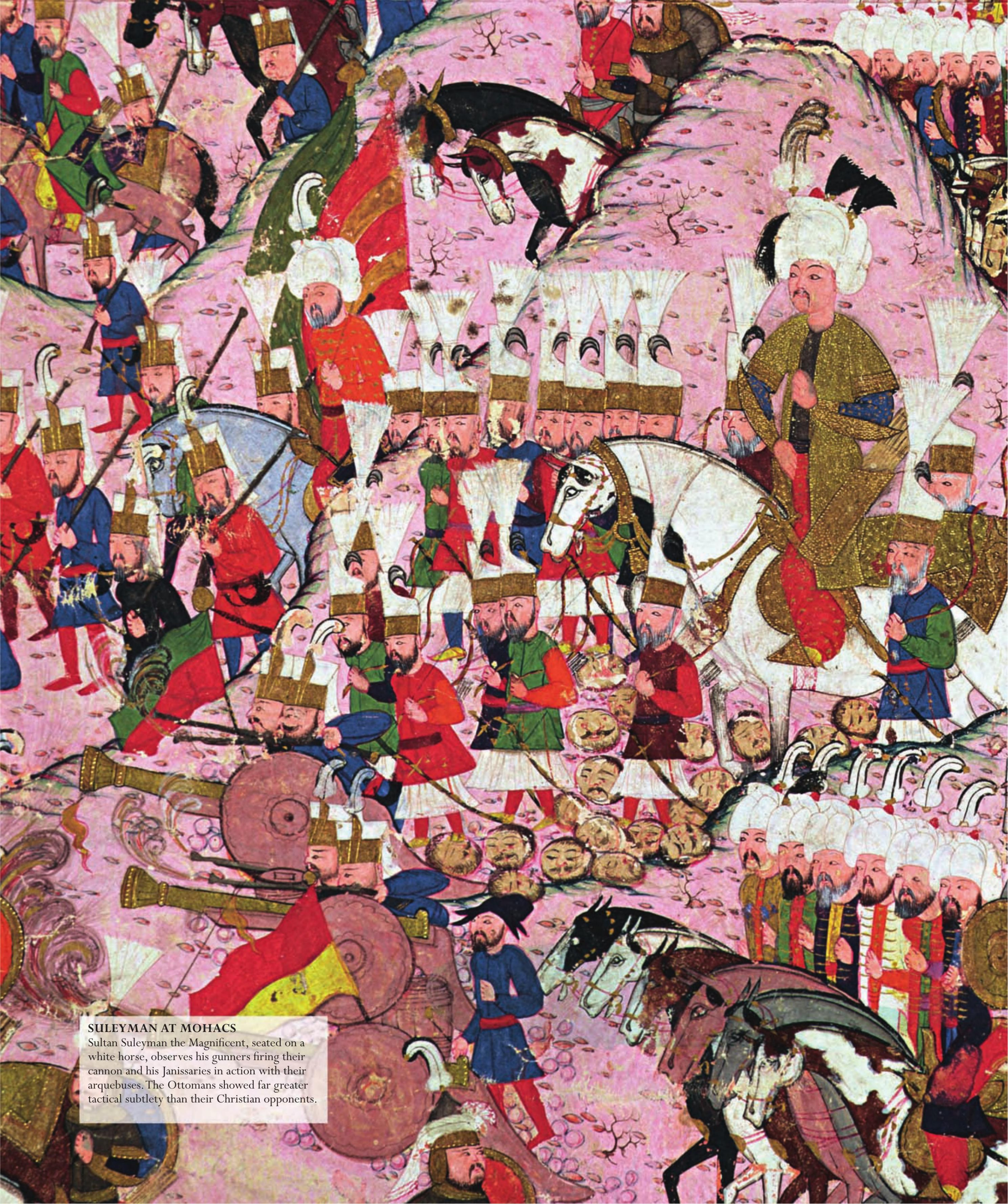

Ball trigger

▼ GURZ

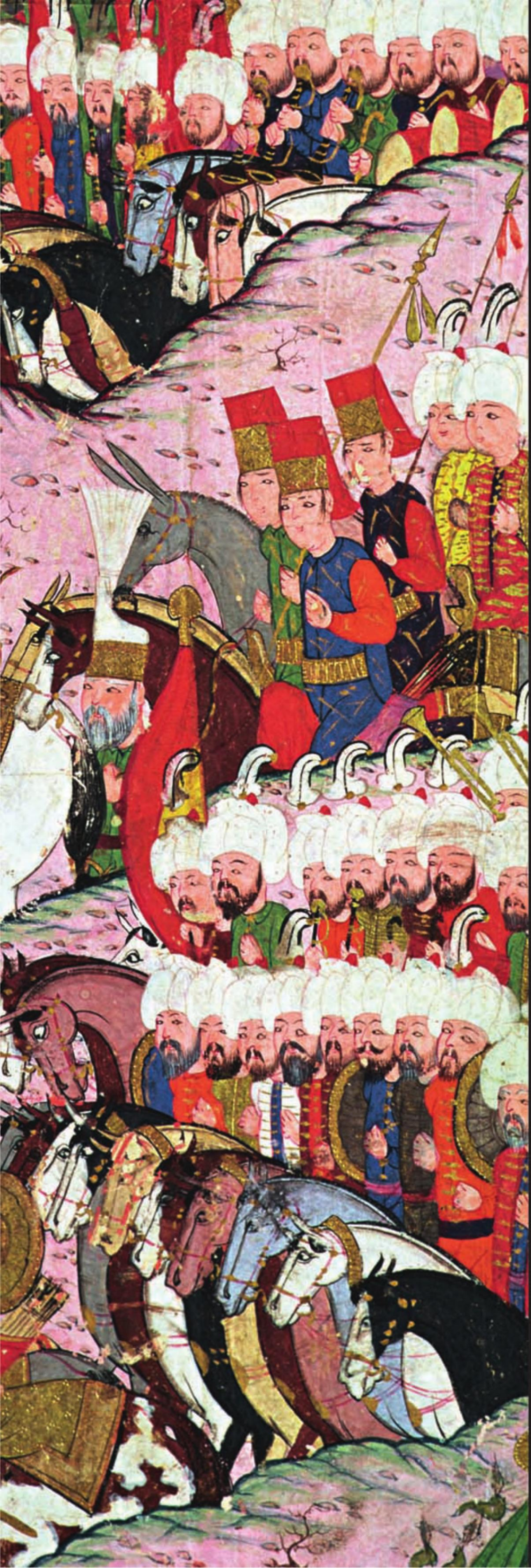
Date	18th century
Origin	Turkey
Weight	1.16kg (2½lb)
Length	70cm (27½in)

Made of iron, this mace has a spirally fluted hollow shaft and a ribbed head, surmounted by a gilt finial. It was primarily a horseman's weapon.


Ribbed head
Hollow shaft



SULEYMAN AT MOHACS
Sultan Suleyman the Magnificent, seated on a white horse, observes his gunners firing their cannon and his Janissaries in action with their arquebuses. The Ottomans showed far greater tactical subtlety than their Christian opponents.



CAVALRY AND CANNON

THE BATTLE OF MOHACS

In 1526, Sultan Suleyman the Magnificent of the Turkish Ottoman Empire led a powerful army into the territory of King Louis II of Hungary and Bohemia. Meeting Louis' army at Mohacs, Süleyman's forces resisted with skilfully deployed weaponry and traditional fighting skills.

When Suleyman's army marched out of Constantinople on 16 April 1526, its goal was no secret. Expanding his empire in southeastern Europe, Süleyman had already taken the Serbian capital, Belgrade, in 1521. Hungary was the next stepping stone towards his ultimate goal, the Habsburg city of Vienna. King Louis had time to prepare his defences during the Turks' slow progress north. Appeals to other Christian leaders for military aid fell on deaf ears, however, and even the Hungarian nobles who owed Louis allegiance were reluctant to accept his authority.

Through a wet summer that made progress arduous, Suleyman's army advanced along the bank of the Danube, accompanied by a fleet of supply boats. On 14 August they reached the Drava River, a tributary of the Danube that formed Hungary's natural border. Louis' best policy might have been to defend the river crossing here, but the Ottoman forces crossed the rain-swollen flood unmolested. It took them five days to move 300 cannon and an estimated 50,000 to 100,000 men across a skillfully constructed bridge of boats. Louis, meanwhile, awaited the invaders near Mohacs, blocking their road to his capital, Buda.

KNIGHTS AND CANNON

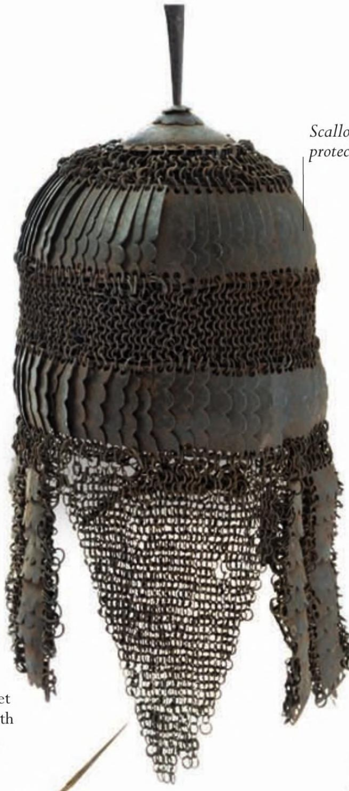
The battle took place on 29 August. Most of Louis' army consisted of armoured knights, although he also had a significant number of cannon. In the tradition of Christian Europe, he intended to gamble on the shock impact of his charging knights to win the day. Suleyman arranged his variegated forces in anticipation of this. His impressive array of cannon were tied together to form a barrier across the battlefield, reinforced by the Ottomans' elite Janissary infantry armed with arquebuses (small-bore matchlock weapons). In front of this line of gunpowder weapons he placed his own heavy cavalry, the *sipahi*. They were less well armoured than their Christian counterparts, and many were still armed with the composite bow of their Central Asian ancestors. On the flanks, the light irregular horsemen, the *akinji*, awaited the chance to harass, pursue, and plunder. The sultan himself took up position in the rear, surrounded by his household cavalry.

The Hungarians opened the battle by firing their cannon. Then the armoured knights, with King Louis in their midst, thundered forward towards the Ottoman army. Most likely following a prearranged tactical plan, the *sipahi* melted away in front of the knights' onslaught, revealing the line of cannon behind them. As the knights bore down upon the muzzles of the guns, the Ottomans opened fire. Amid a carnage of slaughtered horses and fallen riders the charge was brought to a halt. The Ottoman cavalry then launched a counterattack, and a savage mêlée ensued. Meanwhile the *akinji* had stolen around to the Christian rear, and were plundering the camp and massacring the camp followers.

Louis' army disintegrated. The individual survivors sought to escape through woods and swamps, and the king himself died while fleeing – his body was not found for months. Buda was occupied and Hungary became an Ottoman territory.

MUGHAL ARMOUR AND WEAPONS

The Mughal Empire had its beginnings in 1526, when steppe nomads from Central Asia swept into India from the northwest, occupying much of the subcontinent by the late 17th century. They were heavily influenced by Persia, and brought with them similar weapons, including guns. The Mughal army was divided into cavalry, infantry, and artillery. In similar style to the Mamluks, the heavy cavalry wore mail and plate armour and rode armoured horses, fighting with bow, lance, and sword. Armoured elephants saw limited use as they were unreliable and difficult to control. The infantry fought chiefly with guns and swords, but lacked a coordinated command structure, which limited their effectiveness.



Scalloped plates protect the skull

▲ TOP

Date 17th century

Origin India

Material Ferrous metal, textile (lining fragment)

Made of horizontal bands of vertically arranged plates joined by mail, this helmet originally had a heavily padded lining. The triangular section of mail hung in front of the face.

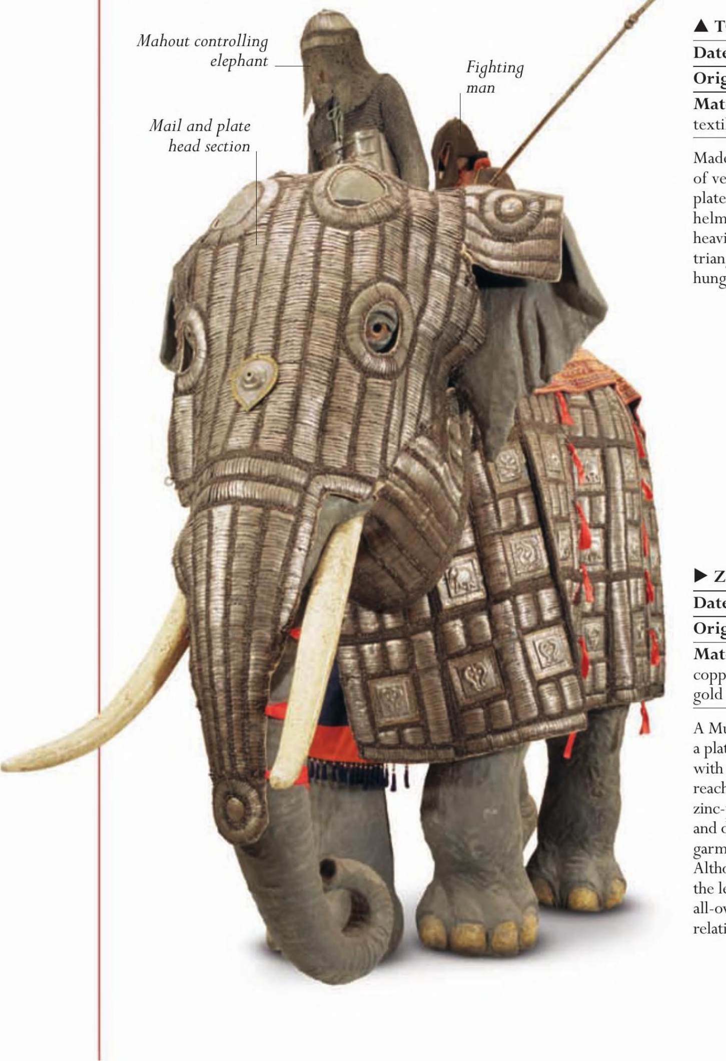
▼ ELEPHANT ARMOUR

Date c.1600

Origin India

Material Ferrous metal, copper alloy, leather

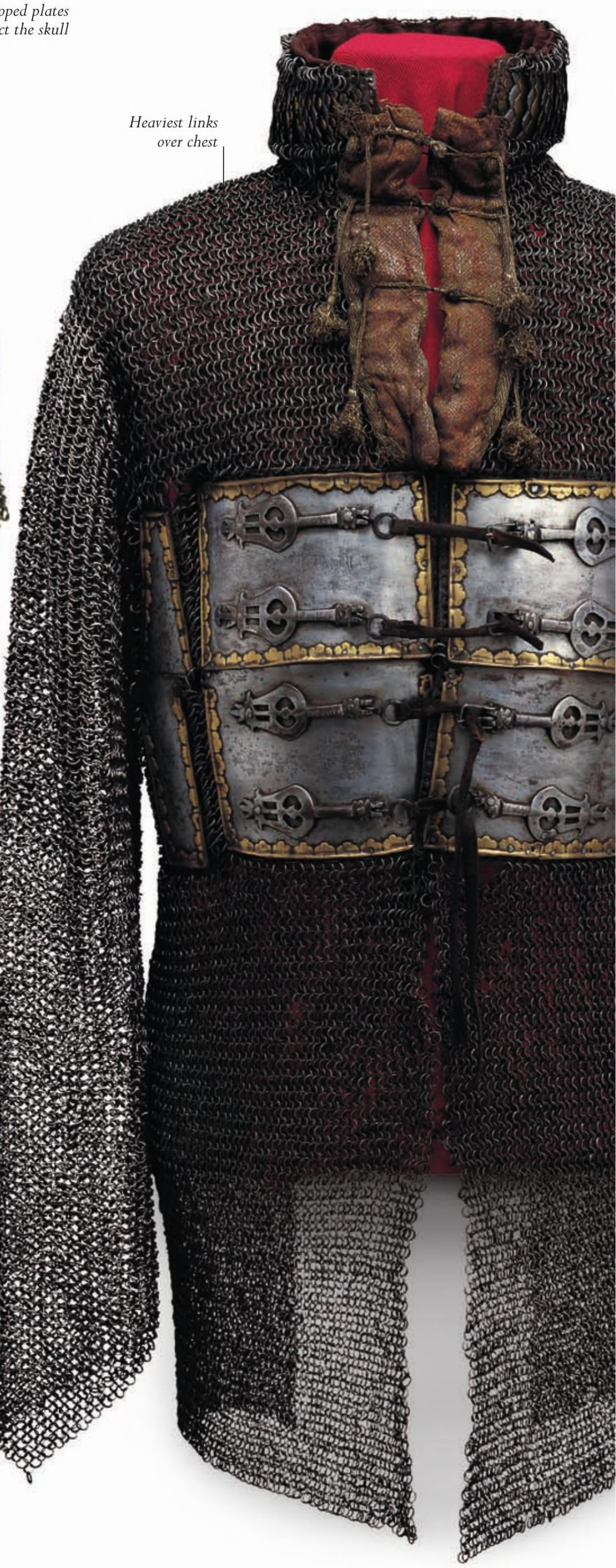
Panels of mail and plate were used for elephant armour. These were inset with plaques that were decorated with flowers, fish, and running elephants. A pair of swords could be sheathed above the tusks.



Mahout controlling elephant

Fighting man

Mail and plate head section



Heaviest links over chest

▶ ZEREH BAGTAR

Date Early 17th century

Origin India

Material Ferrous metal, copper alloy, leather, red silk, gold threads

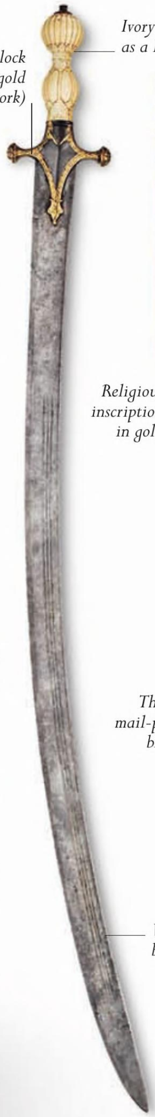
A Mughal horse-warrior wore a plated cuirass combined with a coat of mail that reached his knees. It was often zinc-plated to prevent rusting and damage to the padded garment worn underneath. Although it did not offer the level of protection of an all-over plate armour, it was relatively light and flexible.

▼ TALWAR

Date	Early 17th century
Origin	India
Weight	1.04kg (2¼lb)
Length	95.7cm (37¾in)

The carved ivory grip is different from the usual iron Indo-Muslim hilts fitted to *talwars*, but is typical of the luxurious tastes of the Mughal court. The early blades, such as this, were slightly less curved than later models.

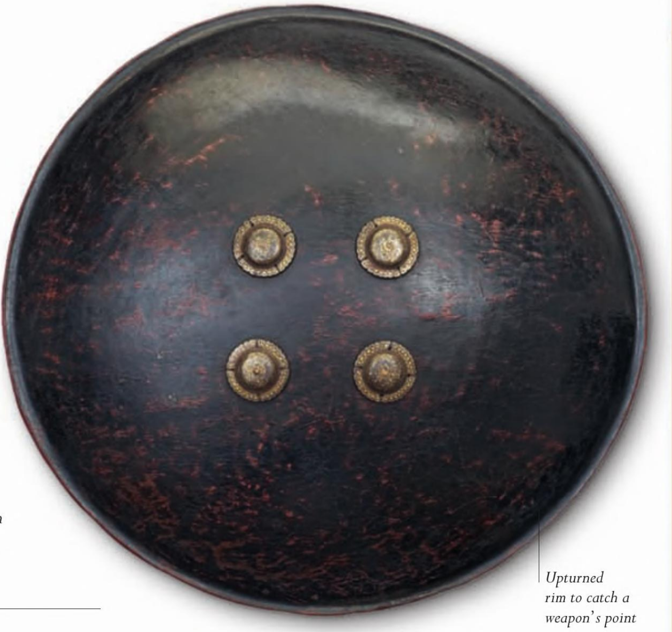
Brocade facings

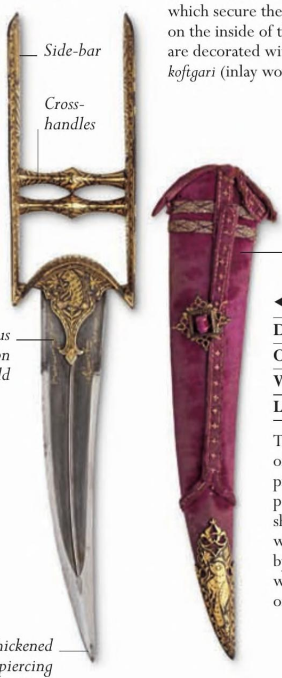

Iron quillon block decorated with gold koftgari (inlay work)
Ivory grip carved as a lotus bud
Wootz steel blade

▶ DHAL

Date	18th century
Origin	India
Weight	2.5kg (5½lb)
Diameter	60cm (23½in)

This domed shield was made of thick rawhide dried in a mould and coated with lacquer to keep the moisture out. The four iron bosses, which secure the handgrips on the inside of the shield, are decorated with gold *koftgari* (inlay work).

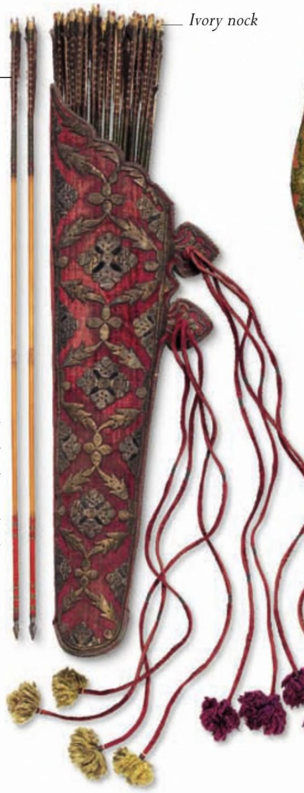

Upturned rim to catch a weapon's point


Side-bar
Cross-handles
Scabbard worn through sash
Religious inscription in gold
Thickened mail-piercing blade tip

◀ KATAR

Date	1760
Origin	India
Weight	525g (18½oz)
Length	44.6cm (17½in)

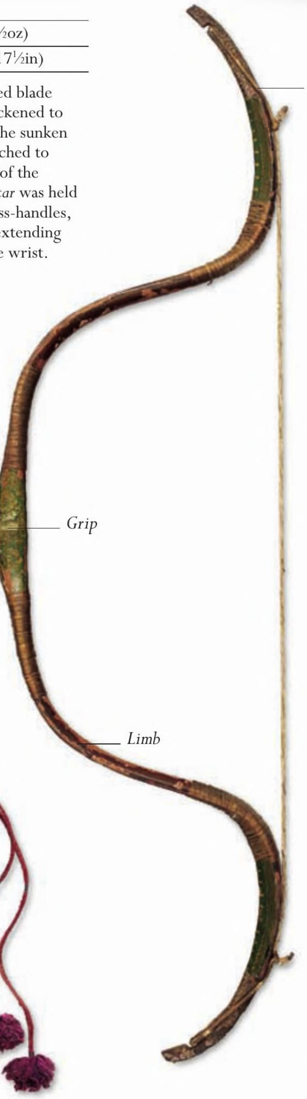
The tip of the curved blade of this dagger is thickened to pierce mail, while the sunken panels have been etched to show the structure of the wootz steel. The *katar* was held by gripping the cross-handles, with the side-bars extending on either side of the wrist.


Ivory nock
Fletching

▶ TARKASH AND TIR

Date	18th century
Origin	India
Weight	710g (25oz); (Arrow) 18g (¾oz)
Length	(Arrow) 73cm (28¾in)

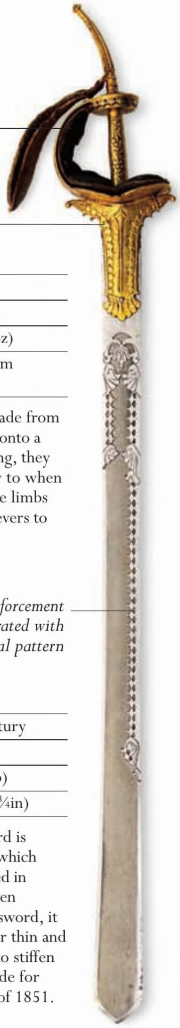
This embroidered velvet quiver (*tarkash*) was worn on the right hip, balanced by a matching bowcase on the left. The painted bamboo arrows (*tir*) were fitted with ivory nocks, three low-cut fletchings, and armour-piercing heads.


Solid ends, called siyahs in Persian
Grip
Limb

◀ KAMAN

Date	18th century
Origin	North India
Weight	550g (19½oz)
Length	(Strung) 95cm (37½in)

Mughal bows were made from horn and sinew glued onto a wooden core. Unstrung, they bent the opposite way to when strung. The ends of the limbs were solid, acting as levers to assist in drawing.


Velvet hilt pad
Gilded basket hilt
Reinforcement decorated with floral pattern

▶ KHANDA

Date	Early 19th century
Origin	India
Weight	1.3kg (2¾lb)
Length	93.3cm (36¾in)

The blade of this sword is made of wootz steel, which could only be produced in limited quantities. When hammered out into a sword, it was of necessity rather thin and had to be reinforced to stiffen it. This sword was made for the Great Exhibition of 1851.

KEY DEVELOPMENT

CONFLICT IN EAST ASIA

In the 16th and 17th centuries, a number of large-scale wars were fought throughout Japan, Korea, China, and southeast Asia. Many of these conflicts used innovative technology, including early gunpowder weapons and heavily armoured ironclad ships.

In Japan, the era from 1467 to 1615 is known as the Sengoku Period, "the age of the country at war", during which powerful regional warlords, the *daimyo*, clashed regularly. The most ambitious of them – such as Oda Nobunaga and Toyotomi Hideyoshi – aspired to unite Japan under single rule, a goal eventually achieved by Tokugawa Ieyasu, founder of the long-lived Tokugawa shogunate.

THE SAMURAI AND THE ASHIGARU

The samurai warriors of the warlords' armies were shifting away from their origins as mounted archers, in favour of fighting on foot, using spears and swords. Their main sword was the two-handed *katana*, worn blade-upwards so that a samurai could draw it and deliver a cut in a single, sweeping movement. Although individual samurai became legendary for their fighting prowess, the peasant foot soldiers, the *ashigaru*, were also a notable force. After earlier experiments with Chinese firearms, from the 1540s onwards, the *ashigaru* adopted the European matchlock arquebus, which could be used to great effect by trained, disciplined squads. Castle-building was another important feature of the period, and many elaborate stone-and-wood structures were constructed at this time, often with additional outworks.

GUNPOWDER AND WARSHIPS

During the 1590s, Japan attempted to invade Korea twice, led by Toyotomi Hideyoshi. Chinese forces helped to defend Korea, and successfully repulsed the invaders. Korean and Chinese land forces had superior gunpowder weapons, typified by the Korean *hwacha*, a multiple rocket launcher capable of firing batches of a hundred incendiary rockets. The main reason for Korean victory, however, was their naval prowess, which was at its peak in 1592–98, during which time Korean admiral Yi Sun-sin won a series of battles with a fleet of cannon-armed, oar-powered ships – the *panokseon* and the iron-armoured *kobukson* (turtle ships).

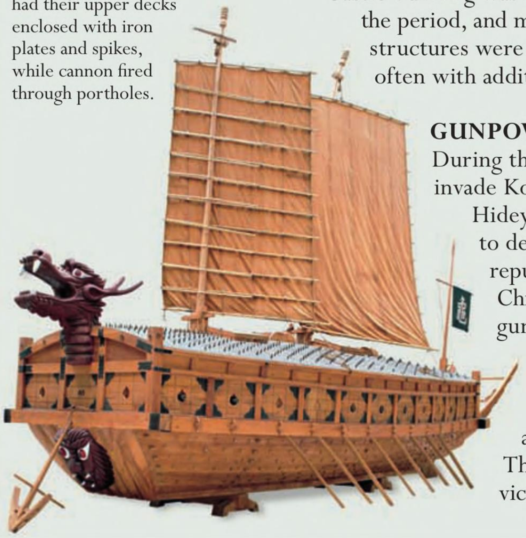
After 1615, the Tokugawa shogunate ended Japan's era of civil war; in China, however, the 17th century was still a period of major conflict. The Manchu, a federation of Jurchen tribes north

KEY **EVENTS**

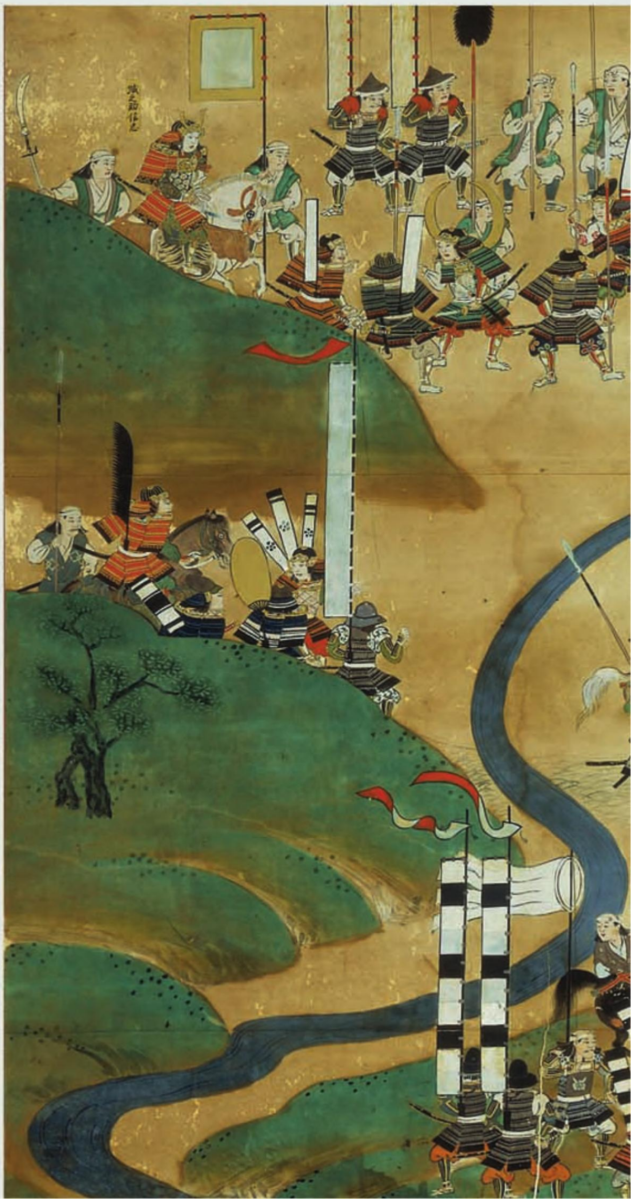
16TH–17TH CENTURY

- **1543** Portuguese voyagers land in southern Japan and introduce the matchlock arquebus, which is quickly copied by Japanese craftsmen.
- **1592** Korean admiral Yi Sun-sin inflicts a crushing defeat on Japanese naval forces at the Battle of Hansando, leading Japan to abandon its first invasion of Korea.
- **1598** A second Japanese invasion of Korea fails, after fierce fighting on land, and naval defeats at Myongyang and Noryang.
- **1600** Victory in the Battle of Sekigahara enables Tokugawa Ieyasu to take supreme power in Japan. He founds the Tokugawa shogunate.
- **c.1615** Jurchen warrior Nurhaci creates the Manchu Banner system, a military organization that proves highly effective against the Chinese.
- **1644** Allowed passage through the Great Wall by a renegade Chinese general, the Manchu occupy Beijing and establish the Qing dynasty.
- **1673–83** Emperor Kangxi of China defeats rebel warlords in the War of the Three Feudatories, and against Ming loyalists on Taiwan.

▼ A KOREAN TURTLE SHIP Used against the Japanese in the 1590s, Korea's turtle ships had their upper decks enclosed with iron plates and spikes, while cannon fired through portholes.

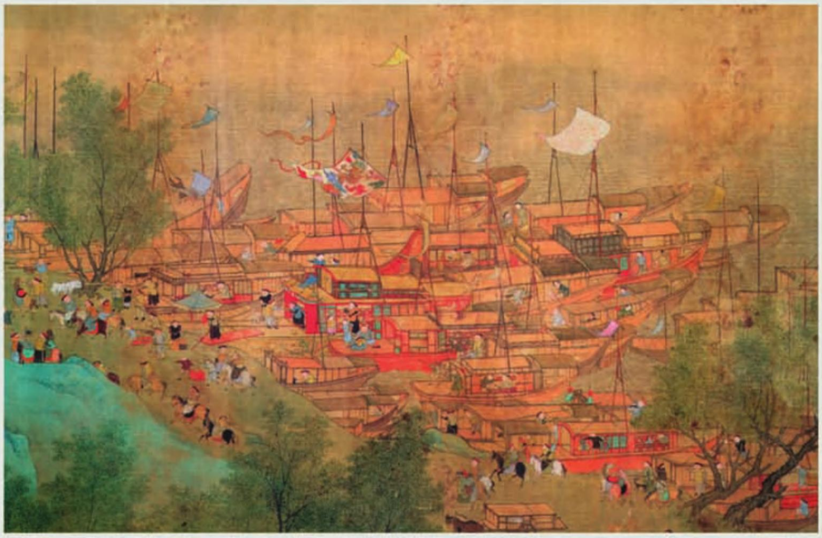


> "As one man can **defeat ten men**, so can a thousand men **defeat ten thousand**"
>
> **MIYAMOTO MUSASHI**, *THE BOOK OF FIVE RINGS*, c.1645

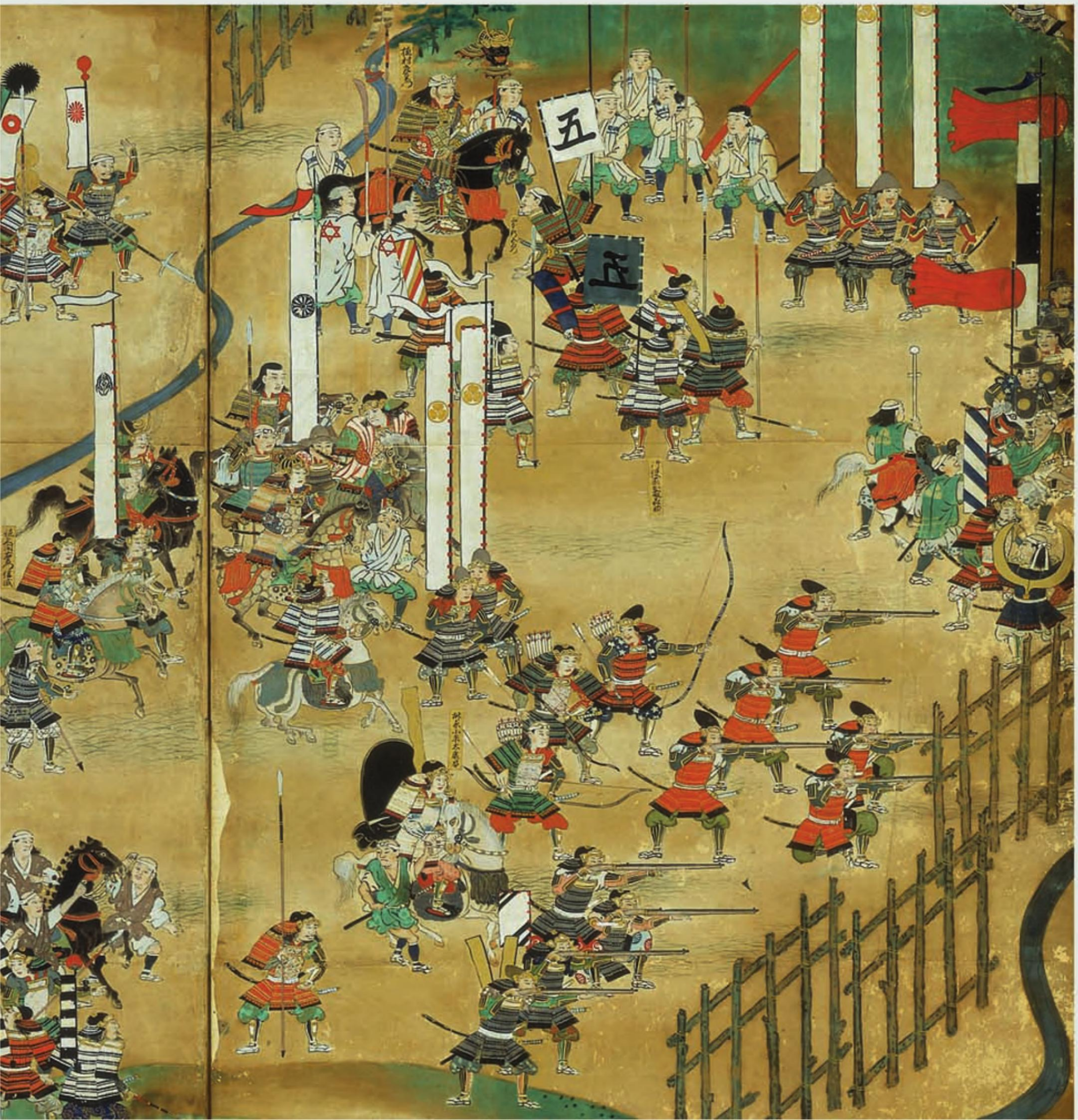


of the Great Wall, created a military organization known as the Eight Banners. In 1644, the decline of the Chinese Ming dynasty led to political chaos that the Manchu exploited, seizing Beijing and establishing the Qing dynasty. It took 40 years of warfare, however, to extend Manchu rule over the whole of China. Originally steppe cavalry fighting with bows, swords, and spears, the Manchu had to adapt to the use of mass peasant armies, naval warfare on river and sea, and an array of Chinese gunpowder weaponry. However, the capture of Taiwan in 1683 by means of a seaborne invasion marked the final triumph of Emperor Kangxi of the Manchu over the Ming loyalists.

In southeast Asia, meanwhile, the warring kingdoms of Burma and Siam were maintaining a very different tradition of warfare, in which armies were based around units of massed war elephants used as a shock force.



▲ EMPEROR KANGXI'S NAVY The Manchu Emperor Kangxi completed the defeat of resistance to his rule on the island of Taiwan with a victory for the Chinese navy at the Battle of Penghu in 1683.



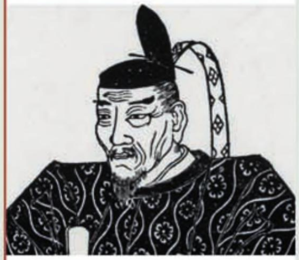
◄ THE BATTLE OF NAGASHINO Fought in Japan in 1575, the Battle of Nagashino is famous for warlord Oda Nobunaga's use of firearms. Protected by a wooden palisade, a mass of Oda's foot soldiers firing arquebuses in rotating volleys shattered the charging cavalry of Takeda Katsuyori.

KEY **FIGURE**

TOYOTOMI HIDEYOSHI

1536–98

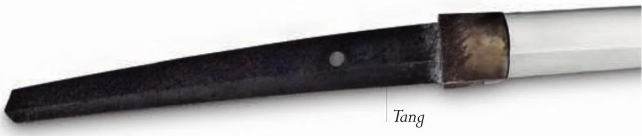
Japanese warlord Toyotomi Hideyoshi rose from peasant stock to prominence in the service of Oda Nobunaga. After Oda – by then the most powerful man in Japan – died in 1582, Hideyoshi won succession. Despite two failed invasions of Korea, he remained in power up to his death.



▲ During his reign, Hideyoshi tried to pacify Japan by banning peasants from bearing arms.

EAST ASIAN SWORDS

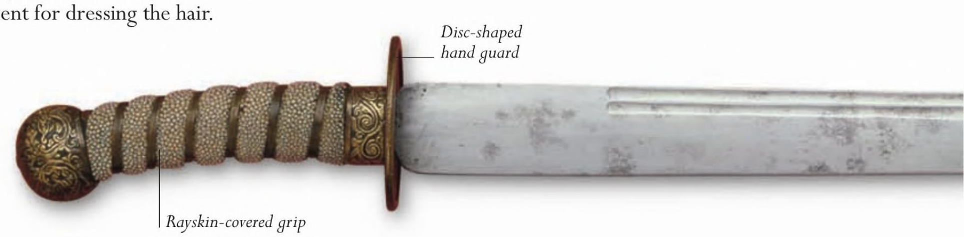
The earliest Chinese swords were straight and double-edged, but single-edged swords date at least as far back as the late Han dynasty (206BCE–220CE), their blade shape evolving into a variety of forms. At first, the Japanese imported swords from China, but by 1000CE, they had perfected their own style of the single-edged, curved blade that did not materially change for the next 1,000 years. Japanese blades were designed to be removable from the rest of the sword, enabling the same blade to be worn for generations, becoming an heirloom within a family. The blades were reset in new mounts, consisting of the *tsuka* (hilt or grip), *tsuba* (hand guard), and *saya* (scabbard). Some swords, particularly short swords and daggers, had pockets in the scabbard for a *kozuka* (a small knife) and a *kogai*, a skewer-like implement for dressing the hair.



▲ KATANA BLADE

Date	15th century
Origin	Japan
Weight	630g (22¼oz)
Length	87cm (34¼in)

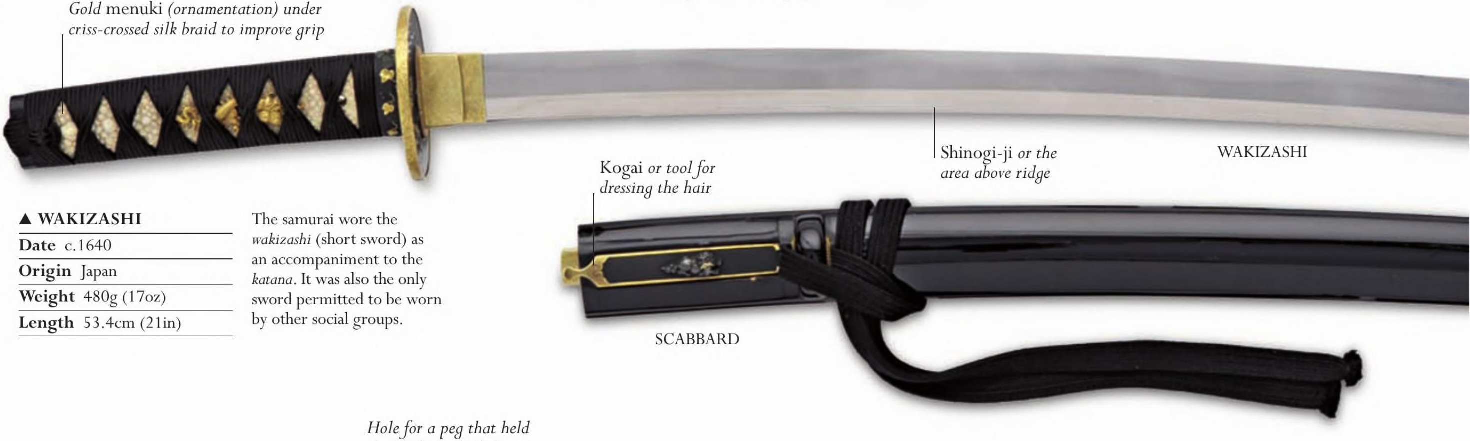
This *katana* blade has been removed from its mountings. It was secured into the wooden hilt by the taper of the tang, and by a bamboo peg, which passed through the hole in the tang and corresponding holes in the hilt.


Disc-shaped hand guard
Rayskin-covered grip

▶ DAO

Date	17th century
Origin	China
Weight	520g (18¼oz)
Length	64cm (25in)

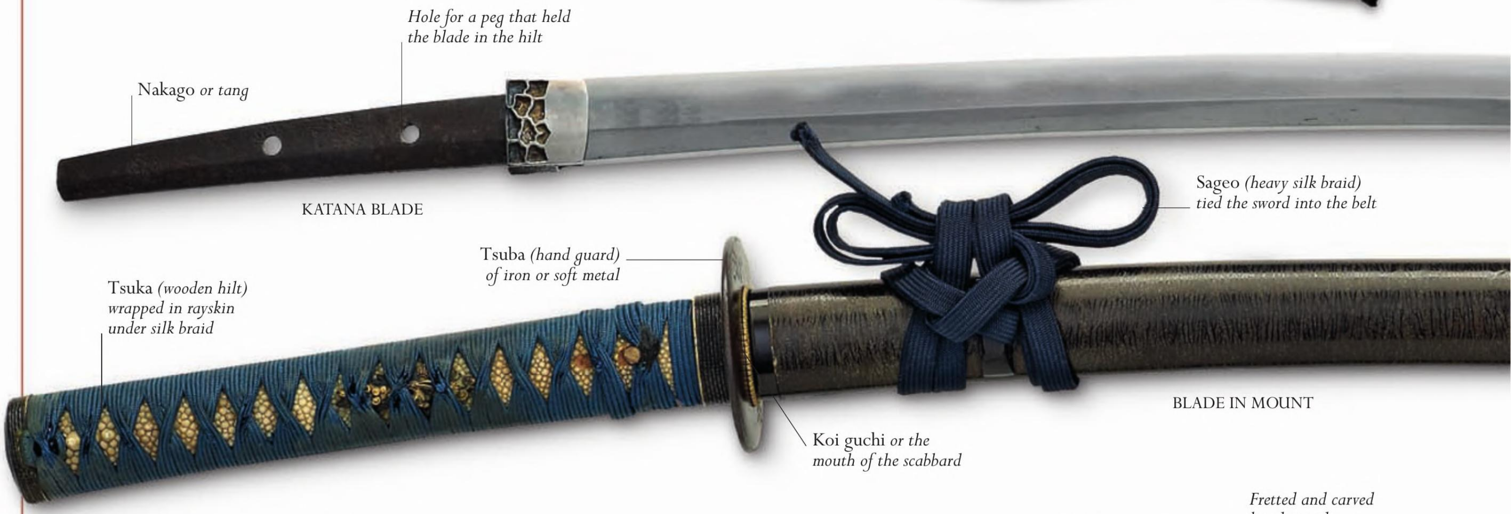
This short, single-edged sword or *dao* has a near-straight *yanmaodao* (goose quill) blade. Primarily a cavalry weapon, its single edge was used for cutting and its point for thrusting.


Gold menuki (ornamentation) under criss-crossed silk braid to improve grip
Shinogi-ji or the area above ridge
WAKIZASHI
Kogai or tool for dressing the hair
SCABBARD

▲ WAKIZASHI

Date	c.1640
Origin	Japan
Weight	480g (17oz)
Length	53.4cm (21in)

The samurai wore the *wakizashi* (short sword) as an accompaniment to the *katana*. It was also the only sword permitted to be worn by other social groups.


Hole for a peg that held the blade in the hilt
Nakago or tang
KATANA BLADE
Sageo (heavy silk braid) tied the sword into the belt
Tsuba (hand guard) of iron or soft metal
Tsuka (wooden hilt) wrapped in rayskin under silk braid
BLADE IN MOUNT
Koi guchi or the mouth of the scabbard

▲ EDO PERIOD KATANA BLADE AND MOUNT

Date	17th century
Origin	Japan
Weight	1.3kg (2¾lb)
Length	1.06m (3½ft)

During the 16th century, samurai began to wear an *uchiganata* (striking sword) thrust edge upwards through their belt; it was easier to draw than the earlier slung *tachi* (long sword). This style of sword came to be known as *katana*, and could only be worn by the samurai class.

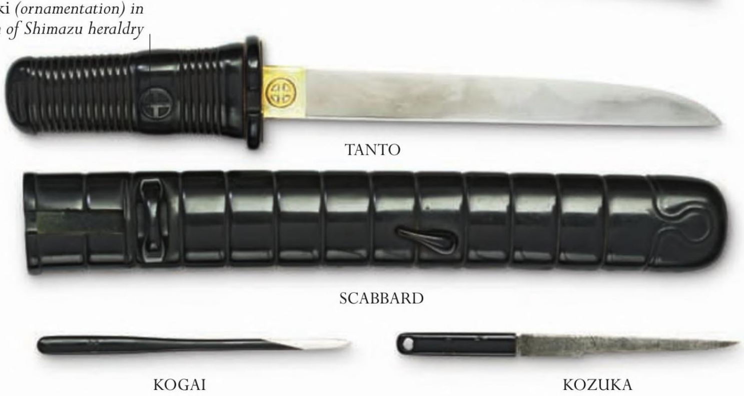
Fretted and carved hand guard
Wooden hilt bound with cord for grip
Eyelet for (missing) tassel

Shinogi *(ridge)*

▶ TANTO

Date 1792
Origin Japan
Length 28.5cm (11¼in)

A *tanto* was a sword or dagger with a blade less than 31cm (12in) in length. It was often worn as an alternative to a *wakizashi*. This example is black-lacquered, with the scabbard housing a *kogai* on the outer face and a *kozuka* at the rear.


Menuki *(ornamentation) in the form of Shimazu heraldry*
TANTO
SCABBARD
KOGAI
KOZUKA

Blade is a composite of iron and steel

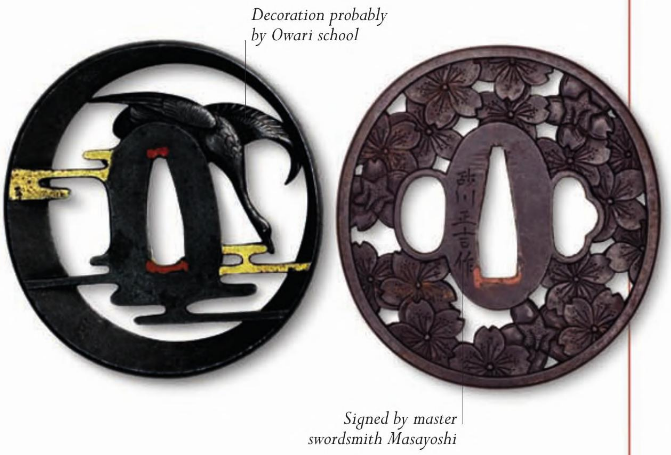
Kissaki *or point section*

Black lacquered wooden saya *(scabbard)*

▶ TSUBA

Date 19th century
Origin Japan
Material Iron, gold
Diameter 6.5–7cm (2¾– 3in)

Originally, *tsuba* (hand guards) were relatively plain, becoming more decorative later. The example with a silhouetted goose flying in front of the moon and clouds (left) is enhanced with gold overlay, while the *tsuba* with a floral motif (right) is chiselled out of an iron plate.


Decoration probably by Owari school
Signed by master swordsmith Masayoshi

Blade more than 60.6cm (23½in) long
Kissaki *or point section*

Lacquered wooden saya *(scabbard)*

▼ JIAN

Date 19th century
Origin China
Weight 950g (33½oz)
Length 88cm (34½in)

Straight, double-edged swords were used in China for over 2,500 years, and were regarded as one of the four traditional weapons. The blades were made of hard steel, with a softer steel welded to each side. Many had a medial ridge.

Medial ridge

EAST ASIAN WEAPONS

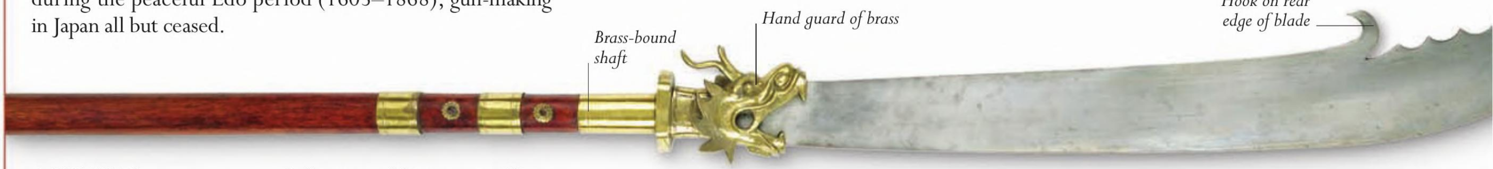
Staff weapons, the bow and the gun – rather than the sword – were often the primary weapons of Japanese and Chinese military forces. Despite their technological advances, east Asian armies' firepower was initially limited: although the Chinese had invented gunpowder, it was reintroduced in a more effective form in the Middle East and Europe in the 16th century. Around the same time, in 1543, the matchlock gun arrived in Japan, and was used in large numbers; however, during the peaceful Edo period (1603–1868), gun-making in Japan all but ceased.

▶ YARI

Date	16th century
Origin	Japan
Length	1–6m (3¼–19½ft)

The *yari* was a straight-headed spear. Its length ranged from 1m (3ft) to 6m (20ft). The longer versions were called *omi no yari*, while the shorter ones were known as *mochi* or *tae yari*. The longest versions were carried by foot troops, and the shorter versions by samurai.

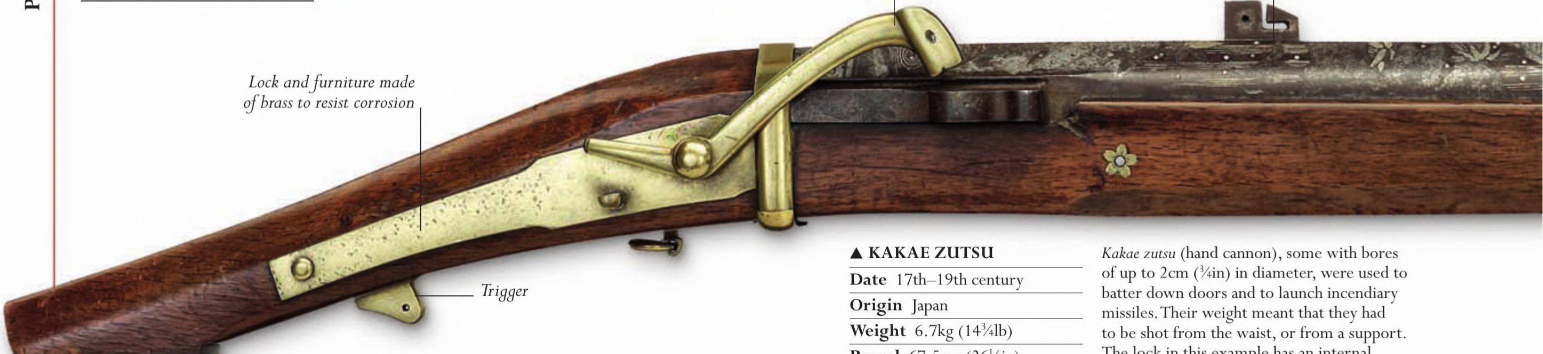
Long wooden shaft


Brass-bound shaft
Hand guard of brass
Hook on rear edge of blade

▲ GUANDAO

Date	19th century
Origin	China
Weight	5.2kg (11½lb)
Length	2.52m (8¼ft)

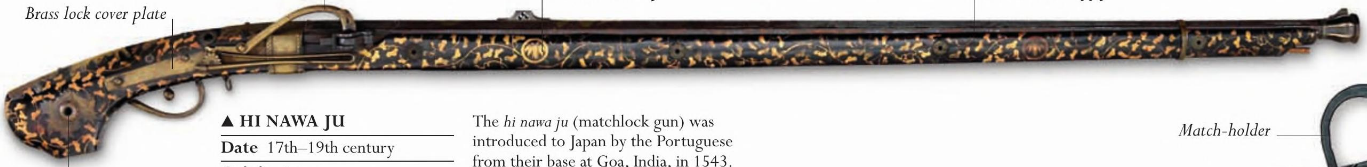
Staff weapons of this type, resembling European glaives, had been in use for centuries in China. Made in the style of a 16th-century weapon, this example has a thin, flexible blade issuing from a cast-brass guard that resembles a dragon's head.


Match-holder
Elaborate sight block holds blades of varying heights for different ranges
Lock and furniture made of brass to resist corrosion
Trigger

▲ KAKAE ZUTSU

Date	17th–19th century
Origin	Japan
Weight	6.7kg (14¾lb)
Barrel	67.5cm (26½in)
Calibre	18.7mm

Kakae zutsu (hand cannon), some with bores of up to 2cm (¾in) in diameter, were used to batter down doors and to launch incendiary missiles. Their weight meant that they had to be shot from the waist, or from a support. The lock in this example has an internal spiral spring to operate the match-holder.

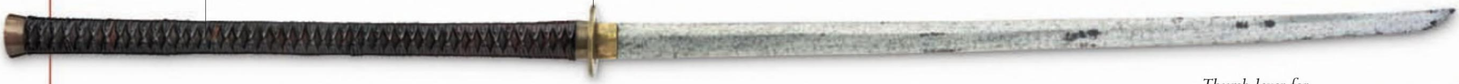

Serpentine match-holder is forward-facing
Owner's heraldry
Bore standardized to simplify ammunition supply
Brass lock cover plate
Decorative brass inlay

▲ HI NAWA JU

Date	17th–19th century
Origin	Japan
Weight	1.29kg (2¾lb)
Barrel	93.7cm (36¾in)
Calibre	15mm

The *hi nawa ju* (matchlock gun) was introduced to Japan by the Portuguese from their base at Goa, India, in 1543. Within 25 years, manufacturing centres were producing thousands of these guns for arming foot soldiers, and the matchlock had become a decisive weapon in battle. The decoration in black and gold lacquer was added later.

Match-holder
Steeply bent butt
Long bar-trigger

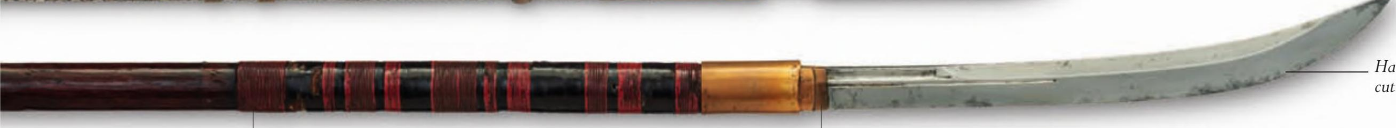

Leather-covered grip
Disc-shaped guard

▲ CHANGDAO

Date	16th century
Origin	China
Weight	2.72kg (6lb)
Length	1.57m (5¼ft)

Chinese long swords of this kind are similar to the Japanese swords known as *ōdachi*. However, unlike the *ōdachi*, the *changdao* has a long tang riveted through the brass pommel cap.

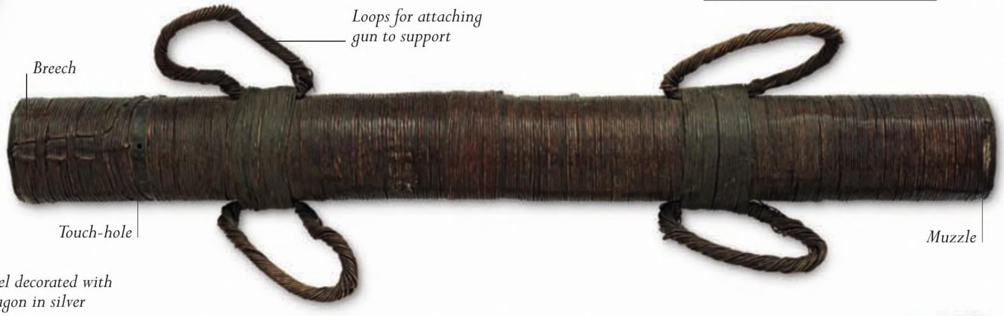
Thumb lever for cocking hammer
Stock made of red oak


Hardened cutting edge
Rattan bindings
Habaki (soft metal collar) to transmit the shock of a blow to the shaft

▲ **NAGINATA**

Date	19th century
Origin	Japan
Weight	1.95kg (4¼lb)
Length	2.75m (9ft)

Naginata blades, mounted on oval wooden shafts about 2m (6½ft) long, were the standard weapon of foot soldiers in medieval Japan. Used as a spear or a fighting staff, they were especially associated with warrior monks, the *sōhei*.


Loops for attaching gun to support
Breech
Touch-hole
Muzzle

◀ **CHINESE SILK GUN**

Date	c.1825
Origin	China
Weight	1.42kg (3lb)
Length	83.2cm (37¾in)
Calibre	63.5mm

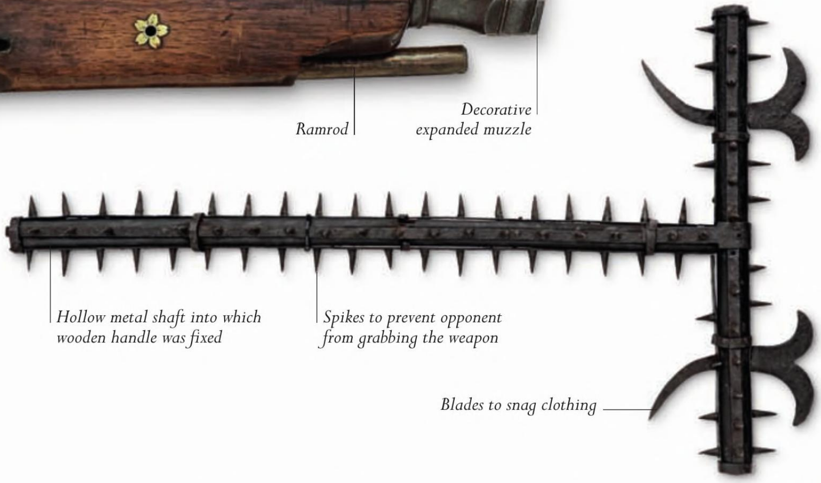
This cannon, designed for portability, was made from a copper tube wrapped with iron wire and silk cord. It derived from earlier guns, which were made from bamboo wound with cord. Chinese paintings show soldiers lying on the battlefield firing similar guns.

Barrel decorated with a dragon in silver
Stock of red oak
Ramrod
Decorative expanded muzzle

▶ **TSUKUBO**

Date	19th century
Origin	Japan
Weight	1.36kg (3lb)
Length	69cm (27¼in)

Although not principally a weapon of war, implements such as this *tsukubo* (pushing pole) were used to overcome and detain criminals in Japan. In towns and cities, racks of these devices were positioned at strategic sites for use by law enforcement officers.


Hollow metal shaft into which wooden handle was fixed
Spikes to prevent opponent from grabbing the weapon
Blades to snag clothing

Red-painted stock

▲ **CHINESE MATCHLOCK**

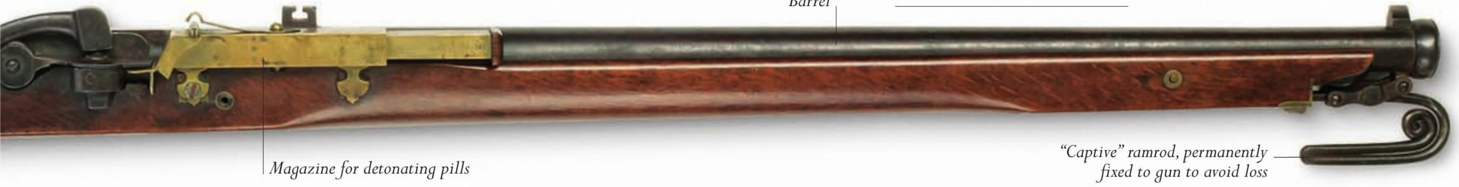
Date	c.1830
Origin	China
Weight	8.6kg (19lb)
Barrel	1.6m (5¼ft)
Calibre	15mm

Unlike the matchlocks used in Japan, on most Chinese guns the match-holder and trigger are one piece, so that when the trigger is pulled up, the match-holder dips down to apply the flame to the touch-hole. This is a simple, functional example, undecorated save for the stock, which is painted red.

▼ **JAPANESE PILL-LOCK CARBINE**

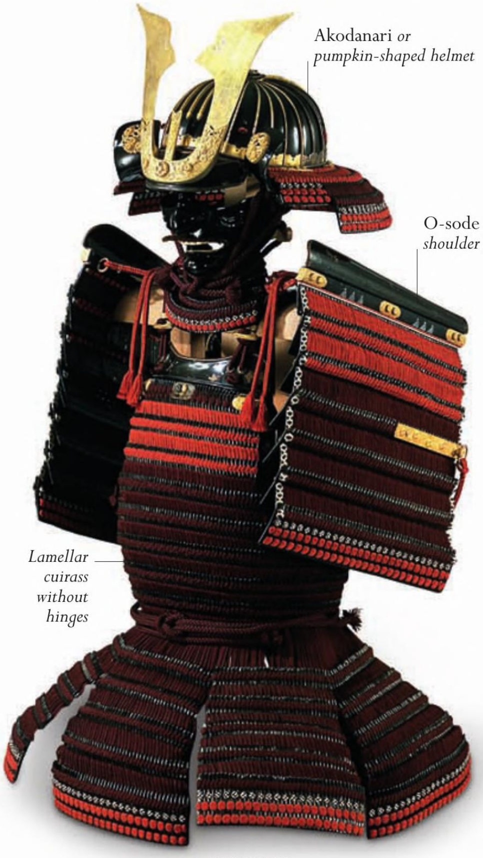
Date	c.1850
Origin	Japan
Weight	3.64kg (8lb)
Barrel	67cm (26¼in)
Calibre	12.5mm

In 1853, American warships forced Japan to open its ports for trade, introducing new technology. Within a few years, the Japanese had adopted percussion ignition for their guns. This example has an automatic dispenser for detonating pills (its ignition primers).


Barrel
Magazine for detonating pills
"Captive" ramrod, permanently fixed to gun to avoid loss

JAPANESE ARMOUR

Prior to the 16th century, Japanese armour was lamellar in construction – made from scales of rawhide or lacquered iron, laced together with leather or silk braid. During the Japanese civil wars of the 16th and 17th centuries, armour made of plate, which was lighter and more effective, was devised. This development proved fortuitous when guns were introduced from Europe in 1543. Although the samurai owned their own distinctive armour, commanders issued simple munitions, armour, and weapons to low-ranking troops. During the peaceful Edo period (1603–1868), samurai were still required to own armour, primarily as a symbol of status and rank.

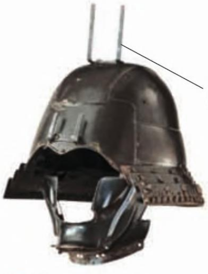


Akodanari *or pumpkin-shaped helmet*

O-sode *or large shoulder guards*

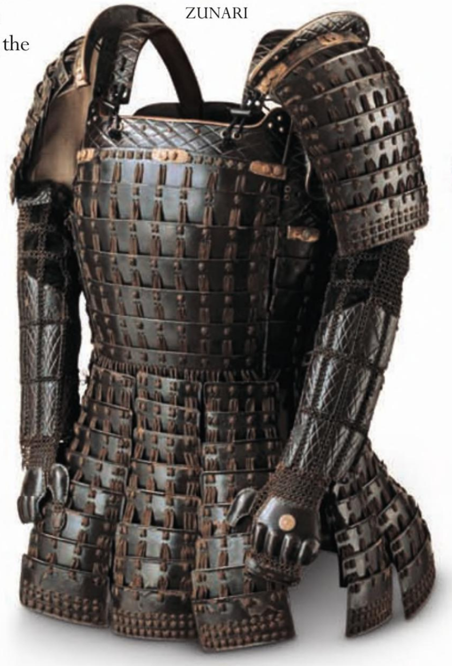
Lamellar cuirass without hinges

DO MARU



Supports for missing crests

ZUNARI



KUSAZURI

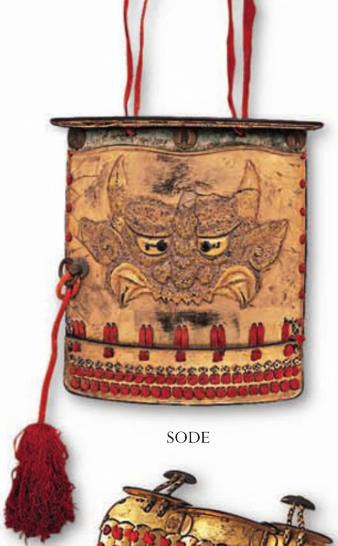
▲ MOGAMI HARAMAKI

Date c.1570

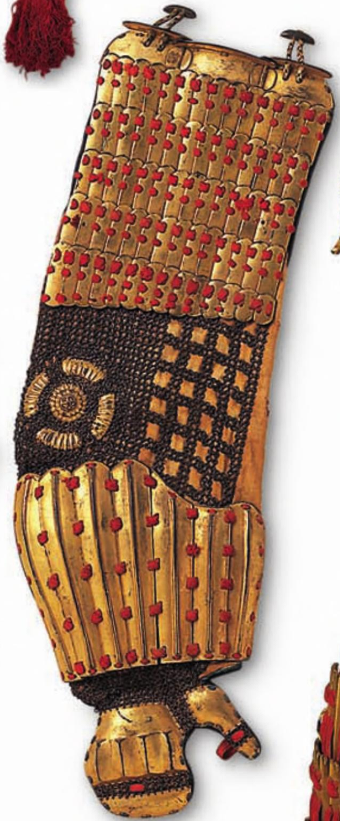
Origin Japan

Material Steel, lacquer, silk braid, textiles

This armour was given to King Philip II of Spain, in 1585. It opened down the back, with each plate in the body divided into five sections and joined by individual small hinges and *sugake* lacing.

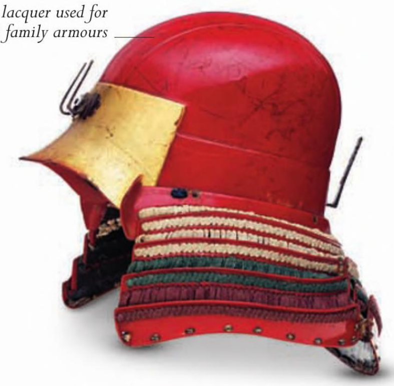


SODE



KOTE

SUNEATE



Red lacquer used for all Ii family armours

▲ DO MARU

Date c.1610

Origin Japan

Material Iron, lacquer, rawhide, silk braid

This formal armour, decorated with the heraldry of Takeda Katsuyori (1546–82), was given to King James I of England as a diplomatic gift. It is signed by the armourer Iwai Yosaemon of Nara.

▲ HINENO ZUNARI KABUTO

Date c.1600

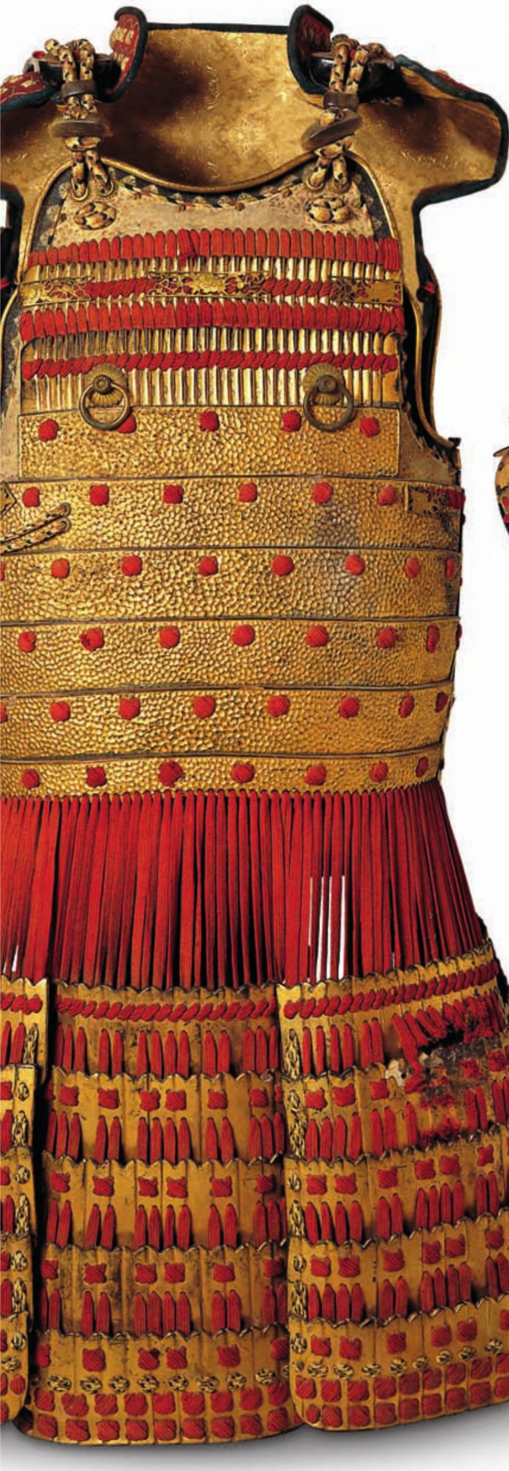
Origin Japan

Material Iron, lacquer, silk braid

This *hineno zunari kabuto*, or head-shaped helmet, was made for a retainer of the Ii family. The neck guard was made up of three sections so that a spear would exit through a gap rather than be deflected onto the neck.

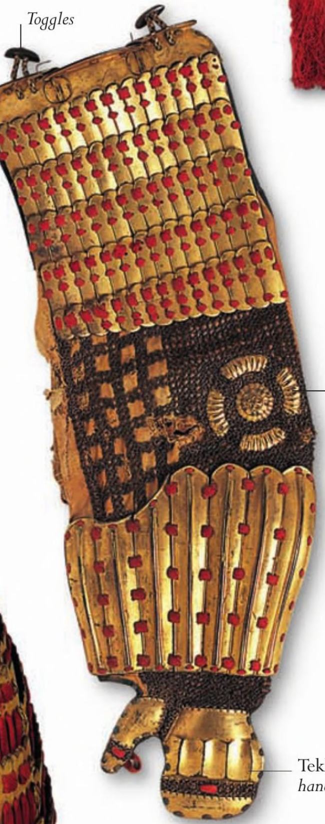
Iron plates joined by hinges and lacing

SUNEATE



HISHINUI DO

Demon's face in raised lacquer



Toggles
Plates sewn to fabric, with mail at the elbow joint
Tekko *or hand defence*

Leather pad prevents the armour rubbing against stirrup-leather when riding

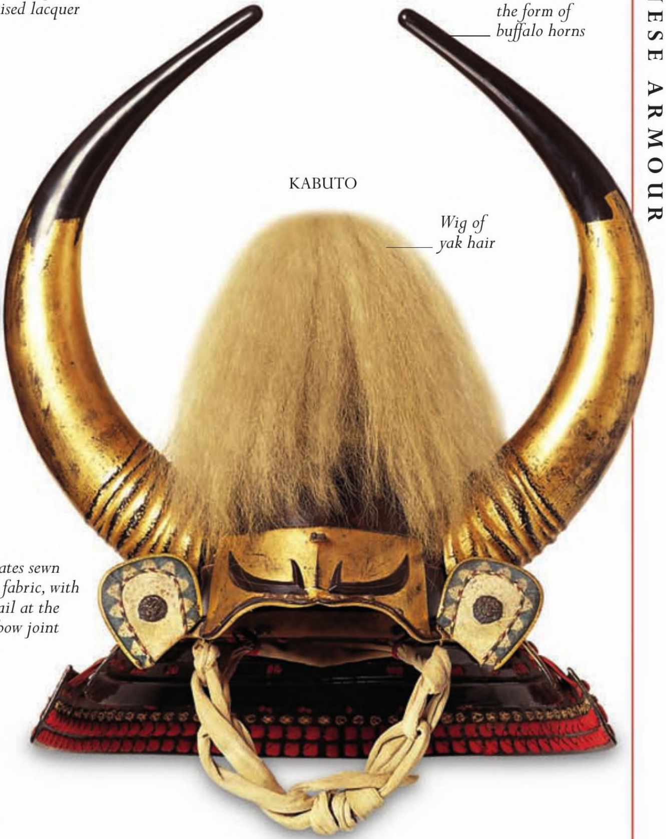
▲ HISHINUI GUSOKU

Date c.1750

Origin Japan

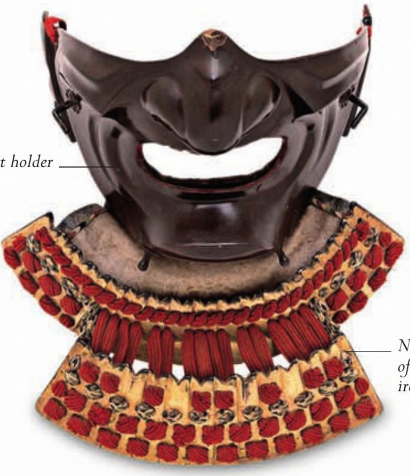
Material Iron, rawhide, lacquer, silk braid, textiles

Made in the Edo period, this armour was more decorative than practical. The gold finish was achieved by dusting wet lacquer with gold dust. Some elements of the armour were made of rawhide to reduce the weight.



KABUTO

Side crests in the form of buffalo horns
Wig of yak hair



MEMPO

Crest holder
Neck guard of lacquered iron plates

▲ KABUTO AND MEMPO

Date c.1750

Origin Japan

Material Iron, rawhide, lacquer, silk

The multi-plate helmet bowl (*kabuto*) is smoothly lacquered, and fitted with a brow plate and crests of lacquered wood and yak hair. The helmet cord was tied to hooks on the cheeks of the iron face mask (*mempo*).

SAMURAI AND FOOT SOLDIERS

THE SIEGE OF OSAKA CASTLE

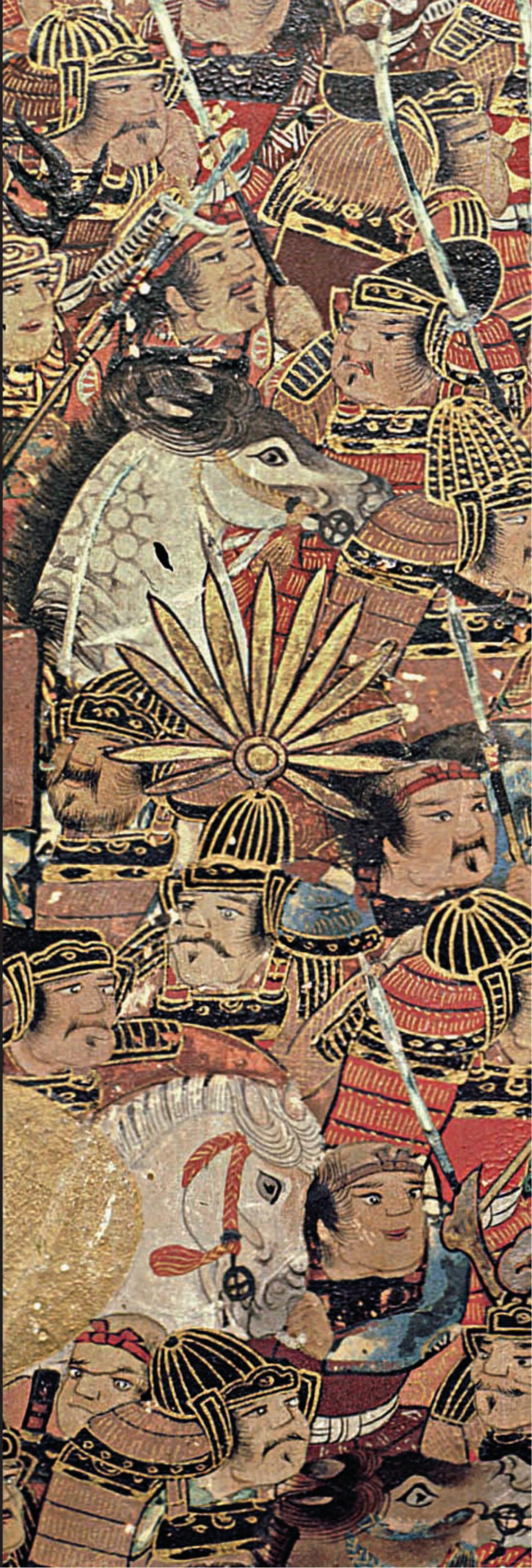
The Sengoku period in Japan was a 150-year era of civil conflict when rival *daimyo* (feudal lords) and their samurai vied for power. The Siege of Osaka castle in 1614–15 was the climax and conclusion of this turbulent era.

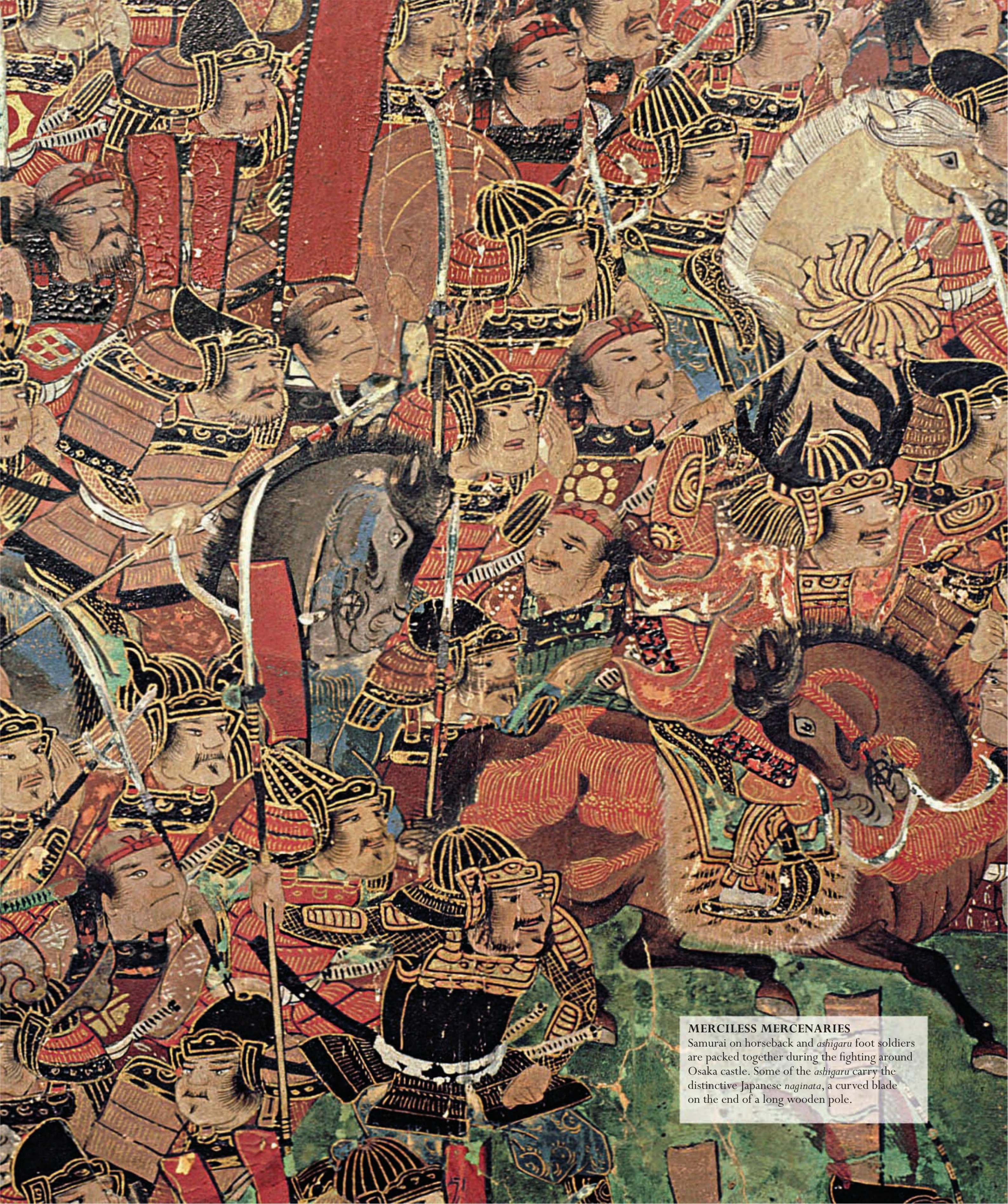
The *daimyo* Tokugawa Ieyasu, effective ruler of Japan from 1600, took the title of shogun (military dictator) for the Tokugawa family. The impressive castle at Osaka was the power base of the rival Toyotomi clan, whose leader, Toyotomi Hideyori, had a better hereditary claim to the shogunate than the Tokugawa. In 1614, Ieyasu invented a pretext to attack the Toyotomi, assembling an army possibly 190,000-strong. *Daimyo* and samurai discontented with Tokugawa rule flocked to join Hideyori in Osaka. They included many masterless samurai, the *ronin*. An experienced warrior, Sanada Yukimura, oversaw the strengthening of the castle's defences, ordering the digging of moats and the building of an earthwork barbican outside the tall stone walls.

The siege began in November 1614. First the Tokugawa captured various strongpoints in the country around Osaka. They then confronted Sanada's earthworks, but their siege weapons – a handful of imported European culverins and several hundred Japanese or Chinese artillery pieces – were powerless against thick earth walls. The Tokugawa decided to attack. They surged forward in their thousands, the *ashigaru* (peasant foot soldiers) armed with long pikes or arquebuses, the samurai, dismounting, wielding spears and swords. It was an impressive sight, the samurai arrayed in elaborate armour, the foot soldiers displaying a mass of fluttering flags attached to their backs by poles. But when they mounted ladders to scale the walls, the attackers were cut down by arquebuses fired through loopholes at the top of the fortifications. Where they breached the outer wall they found themselves trapped in front of inner defences and fired down upon from all sides. The Tokugawa, suffering heavy losses, abandoned their assault and retreated to siege lines where they camped in the bitter winter cold. The defenders nestled inside the castle, living off plentiful food stores.

A TREACHEROUS TREATY

Toyotomi Hideyori then made the fatal error of negotiating a peace deal with the Tokugawa. He was tricked. As soon as the armies dispersed, the Tokugawa ordered the Osaka moats filled in and the earthworks levelled. By the time fighting resumed in the spring of 1615 – after Ieyasu pressed another spurious cause for war – Osaka castle was no longer defensible. The reassembled Toyotomi forces instead sought to pre-empt a siege by winning victory in the open field. The climactic encounter, known as the Battle of Tennoji, came in early June. The Toyotomi adopted a plan in which part of their forces would use a flanking movement to take the enemy from the rear, and then a reserve would enter the battle at the crucial moment. But this strategy was too complex for their loosely coordinated army. Many of the *ronin* attacked at will, and arquebusiers assigned to the reserve opened fire without waiting for orders. In the midst of a chaotic struggle Sanada was killed and his severed head displayed to the demoralized troops. A belated sortie by the garrison from the castle, led by Hideyori himself, was driven back through the gates. As Tokugawa cannon battered the stone walls and parts of the castle caught fire, Hideyori committed *seppuku* (ritual suicide). The Tokugawa shogunate was destined to last another 250 years.





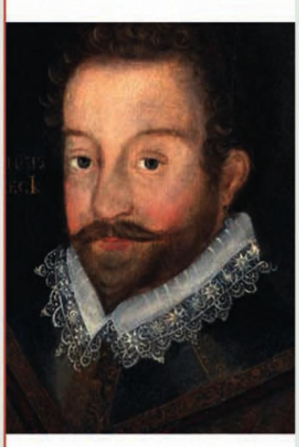
MERCILESS MERCENARIES
Samurai on horseback and *ashigaru* foot soldiers are packed together during the fighting around Osaka castle. Some of the *ashigaru* carry the distinctive Japanese *naginata*, a curved blade on the end of a long wooden pole.

KEY **FIGURE**

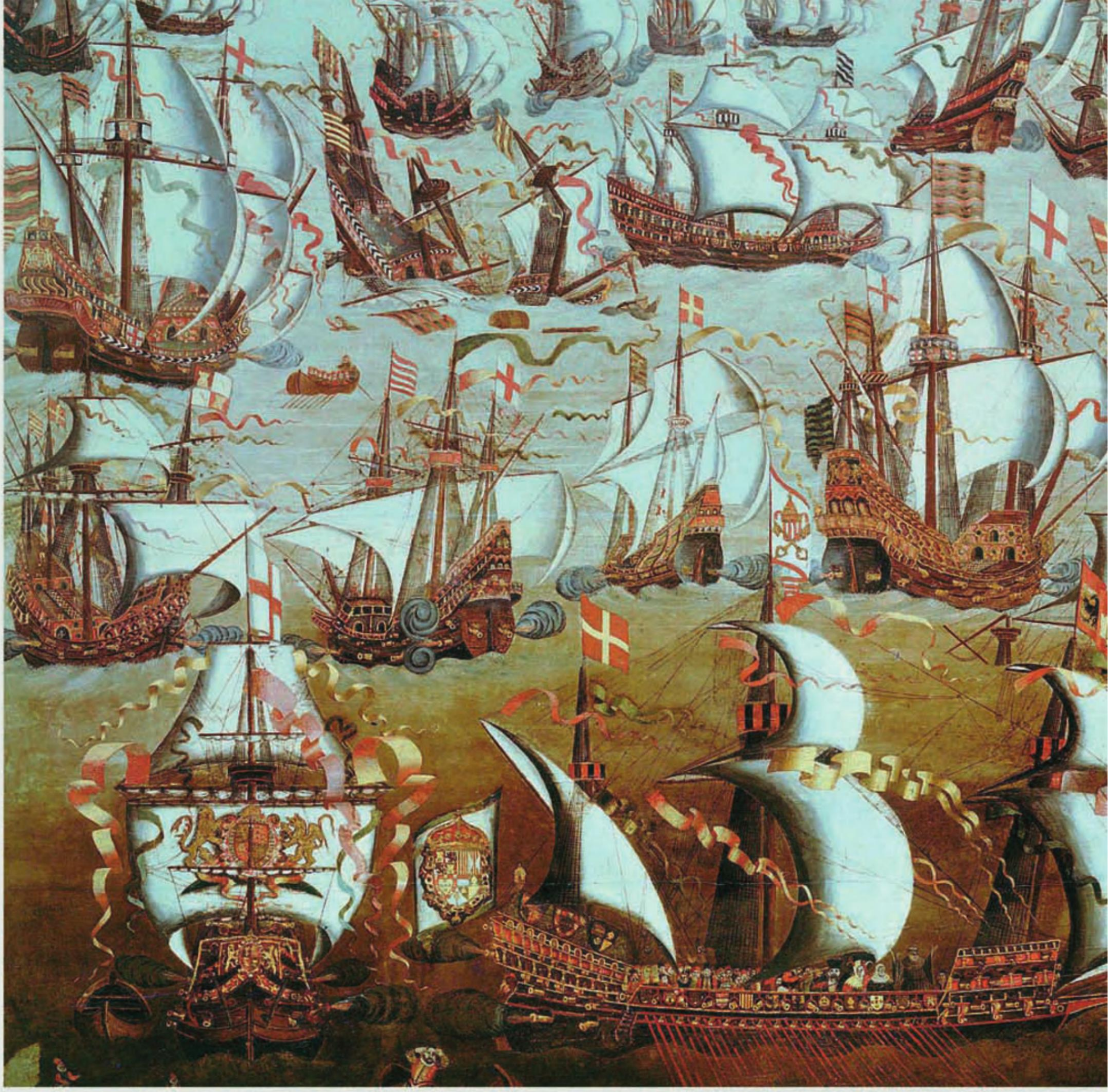
SIR FRANCIS DRAKE

1540–96

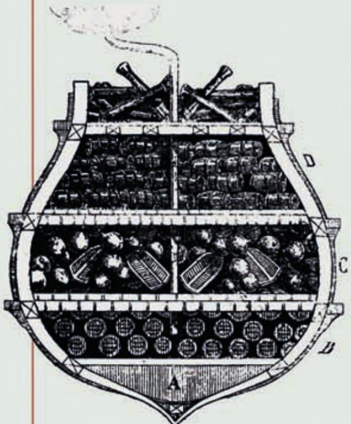
The English privateer Francis Drake ravaged Spanish colonies and shipping in the Caribbean and Pacific in the 1570s. His daring raid on Cadiz, in 1587, was said to have "singed the king of Spain's beard". Drake was made vice-admiral of the English fleet that would resist the Armada.



▲ Drake was knighted in 1580, as the first Englishman to sail around the world.



▶ **THE SPANISH ARMADA** Phillip II of Spain's "Invincible Armada", which was sent to facilitate a cross-Channel invasion of England, is engaged by English galleons firing cannon at the Battle of Gravelines, in August 1588.



▲ **FRENCH FIRESHIP** A ship was packed with combustible material, then set alight and steered towards enemy vessels.

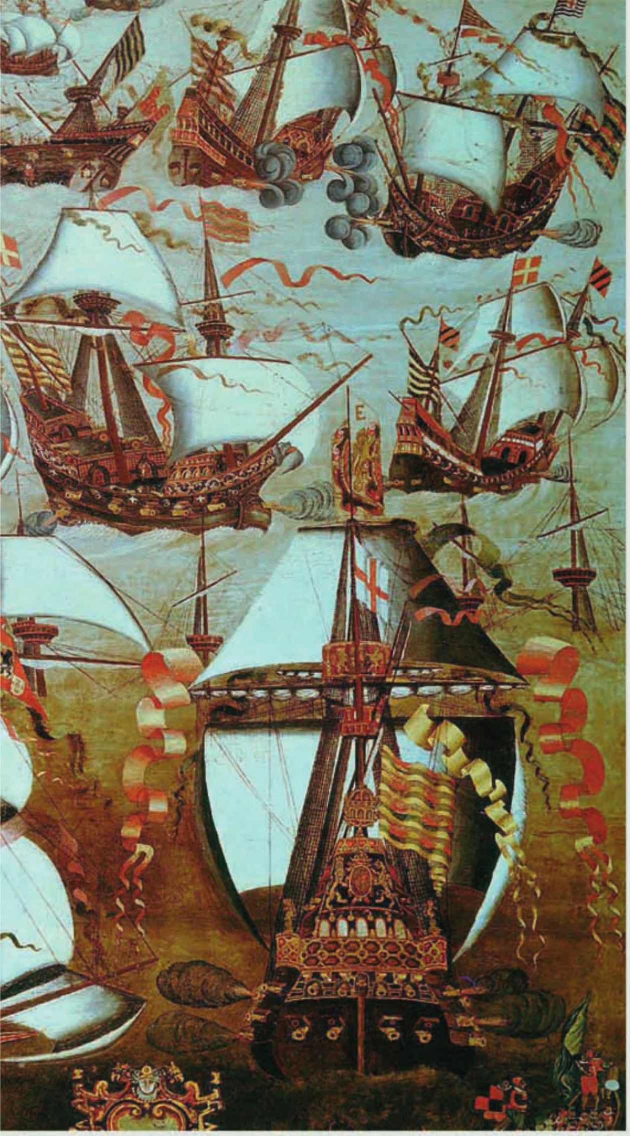
KEY DEVELOPMENT

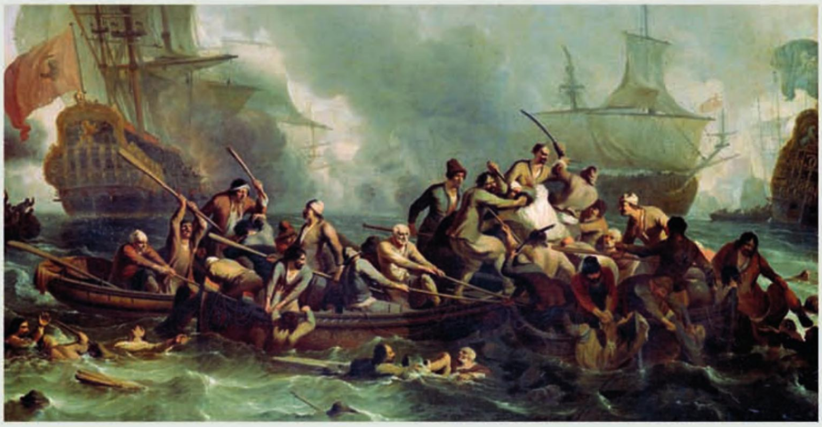
EUROPEAN NAVAL WARFARE

European sailors established oceanic sea routes linking Europe to Asia and the Americas from the late 15th century. The rise of ocean-going sailing ships ushered in a new era of naval warfare, while oared galleys fought for dominance of the Mediterranean.

Galley warfare peaked in the 16th century, as the Turkish Ottoman Empire, aided by privateers, sought control of the Mediterranean. Muslim galleys raided the coast of Italy and landed armies on Christian-held islands, such as Rhodes, Malta, and Cyprus. Christian states responded by deploying large galleys rowed by prisoners using the clumsy but powerful "*scalaccio*" (echelon) system, with five to seven men on each massive oar. Cannon were mounted on the galleys, and the soldiers on board also carried firearms. This firepower was no guarantor of success, however: although a Christian alliance won a major naval victory at Lepanto, in 1571, the Muslims largely had the upper hand at sea.

Galleys tended to dominate the Mediterranean at the end of the 17th century, while sailing ships were traditionally considered of little use in combat: dependence on the wind left them outflanked by nimbler, oared vessels. However,





▲ AT CLOSE QUARTERS
The last naval encounter of the Anglo-Dutch Wars was the Battle of Texel, fought off the coast of the Netherlands, in August 1673. While inconclusive, the battle was contested with savage cannon broadsides and hand-to-hand fighting with cutlasses, daggers, and axes.

galleys struggled to survive in heavy oceanic seas. By the 16th century, states around Europe's Atlantic coast had developed carracks – vessels with high castles (multi-deck structures) fore and aft, and a combination of square and lateen (triangular) sails. They were effective warships, and large carracks, known as "great ships", became prestigious status symbols for early 16th-century monarchs.

EVOLVING SHIPS

From the mid-16th century, the galleon, a slimmed-down, faster version of the carrack, was the pivotal warship. The invention of the gun port allowed large numbers of heavy cannon to be mounted on ships' lower decks, and firing broadsides (from the ship's sides) became the norm. In the 17th century, the galleon evolved into the ship of the line, built to fight in lines together, firing broadsides, and supported by smaller frigates and fireships.

Warships were essential to the states of western and northern Europe as they competed for trade routes and colonies, but permanent navies were expensive to maintain. All countries conscripted armed merchantmen into their navies, and also depended on privateers – licensed pirates who preyed upon foreign states' shipping and colonies.

In the 16th century, Spain had been the dominant naval power, using galleys in the Mediterranean, and galleons in the Atlantic. By the 17th century, the Dutch and English were vying for naval supremacy in a series of large-scale naval battles in the Anglo-Dutch Wars from the 1650s to the 1670s. France, on the other hand, devoted serious resources to naval development only in the reign of Louis XIV, in the 1660s.

The tactics of battles between sailing ships evolved in an ad hoc fashion. When the Spanish sent their Armada against England, in 1588, the smaller English galleons sought to duel with cannon, while the Spanish, their ships packed with soldiers, would have preferred to board: since it was hard to sink a wooden sailing ship with cannon fire, boarding remained a prime tactic. In the 17th century, however, navies formalized a system for exchanging broadsides, but despite this, naval battles remained brutal due to their sheer quantity of firepower.

> "Every squadron **shall endeavour to keep in line** with the chief, **unless the chief be maimed** or otherwise disabled (which God forbid!)"
>
> **FIGHTING INSTRUCTIONS ISSUED TO THE ENGLISH FLEET**, MARCH 1653

KEY **EVENTS**

1500–1700

- **1509** The defeat of an Ottoman, Egyptian, and Gujarati (western Indian) fleet by the Portuguese at the Battle of Diu establishes the superiority of European sailing ships in the Indian Ocean.
- **1511** The English carrack *Mary Rose* is one of the first ships to be built with gun ports.
- **1571** The Battle of Lepanto takes place. Fought between Christian and Muslim fleets in the Mediterranean, more than 400 oared galleys and over 100,000 men are involved (see pp.154–55).
- **1582** The first naval battle in mid-ocean occurs off the Azores – an archipelago in the North Atlantic ocean – with Spanish galleons beating the French and Portuguese.
- **1588** Spain assembles 130 ships for its Armada to sail to the English Channel; less than half return, with most losses due to storms.
- **1639** Dutch admiral Maarten Tromp destroys a Spanish fleet at the Battle of the Downs by making effective use of fireships; this marks the end of the era of Spanish naval dominance.
- **1653** Fighting Instructions drawn up for the British Royal Navy by Admiral Robert Blake (known as the "Father of the Royal Navy") order captains to enter combat in a disciplined line of battle.

MEDITERRANEAN GALLEY

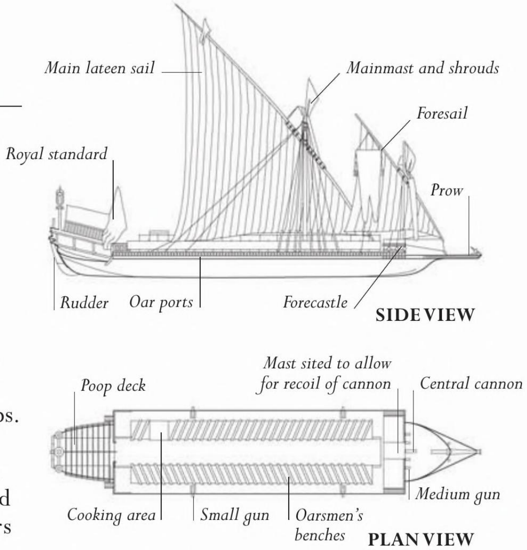
GALERA REAL

The *Galera Real* was no ordinary war galley but a luxury vessel made for Don John of Austria, commander of the Holy League fleet that defeated the Ottoman Turks at the Battle of Lepanto in 1571.

The ship carried up to 400 men, of which 236 rowed the galley, with four men per oar. In addition, there were a number of skilled sailors to steer and manage the two lateen sails, as well as a large detachment of soldiers, many of them armed with arquebuses. On the covered forecastle, beneath a raised fighting platform, the galley had a large central cannon and four medium-sized guns. Four small guns were sited among the oarsmen's stations, two on either side of the ship. In preparation for Lepanto (see pp.154–55), the end of the prow, with its classical figurehead, was cut off so that the central cannon could be angled to shoot down on the Ottoman ships.

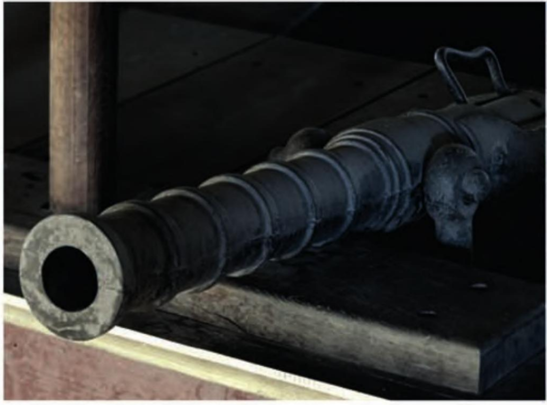
During the battle, the *Galera Real* was rammed by the Ottoman flagship *Sultana*, the enemy prow penetrating as far inboard as the innermost oarsman. Turkish soldiers boarded the galley but were driven back.

This replica of the *Galera Real* was made for Barcelona's Maritime Museum to mark the battle's 400th anniversary.


Main lateen sail
Mainmast and shrouds
Foresail
Royal standard
Prow
Rudder
Oar ports
Forecastle
SIDE VIEW
Poop deck
Mast sited to allow for recoil of cannon
Central cannon
Medium gun
Cooking area
Small gun
Oarsmen's benches
PLAN VIEW

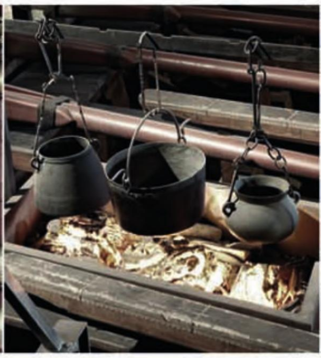
▲ ***GALERA REAL***
The palatial royal flagship was 60m (197ft) long and 6.2m (20¼ft) wide. Sails were used on the open sea, but in battle the galley relied on its oarsmen.

AROUND THE SHIP

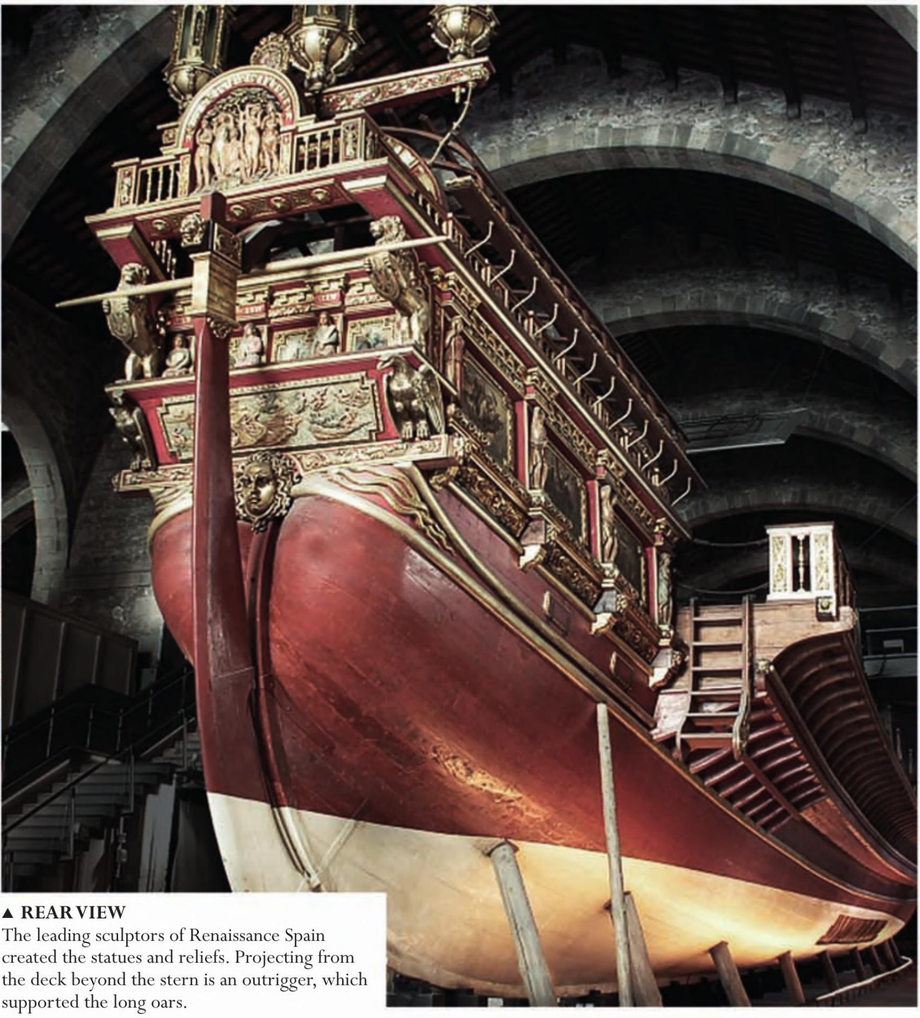


▲ **AUXILIARY GUN**
The small, breech-loading guns on either side of the galley could be swivelled on their mountings. They were loaded with small shot and used as anti-personnel weapons against the deck crew of an enemy galley.

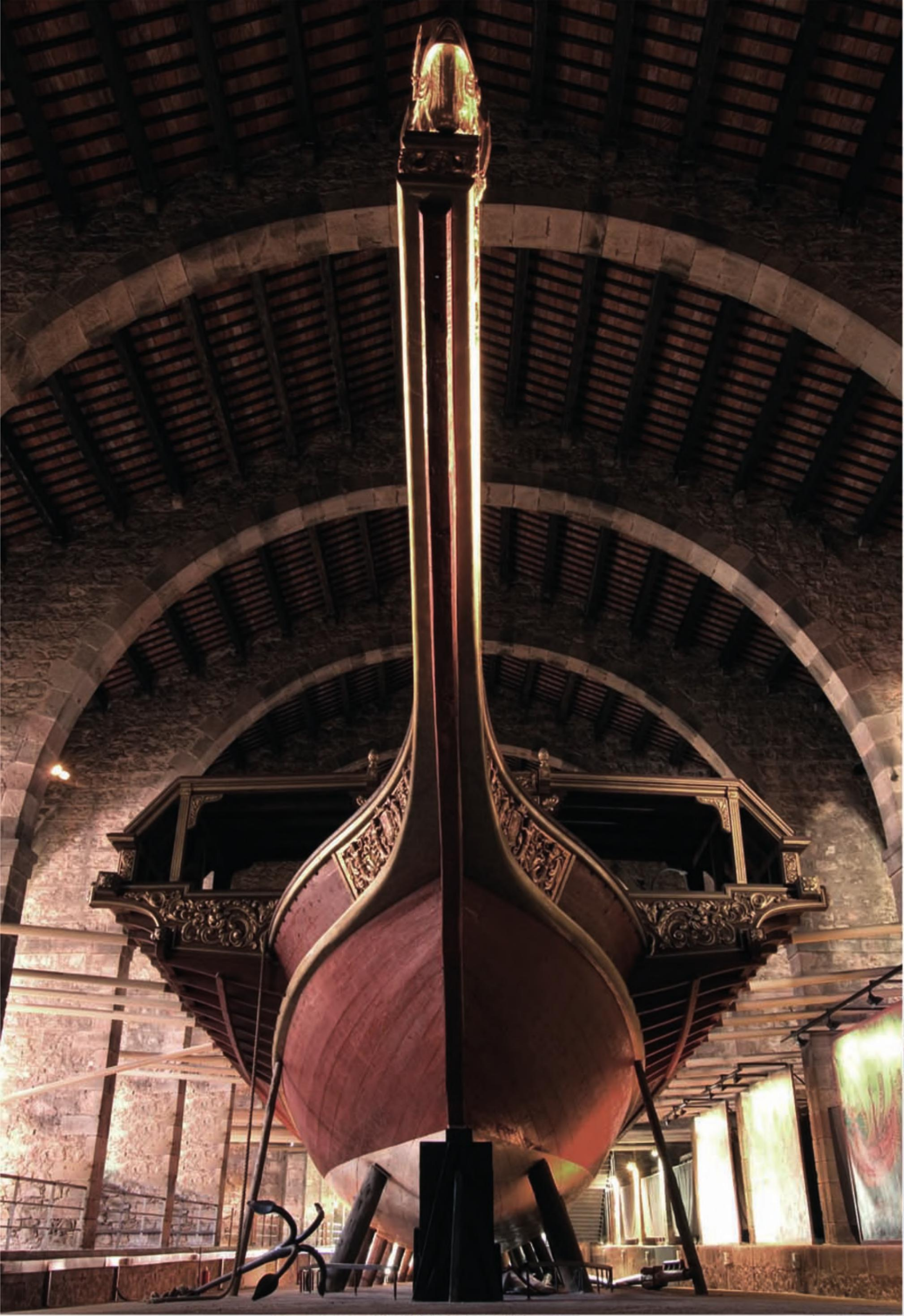
▲ **ORNATE SCUPPER**
Small ports called scuppers were opened to let water run off the deck.



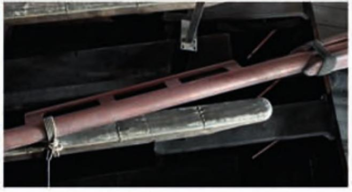
▲ **DECK RANGE**
One of the luxuries on Don John's galley was a range towards the stern. The cooking pots were suspended over the fire.



▲ **REAR VIEW**
The leading sculptors of Renaissance Spain created the statues and reliefs. Projecting from the deck beyond the stern is an outrigger, which supported the long oars.



THE OARS AND OARSMEN



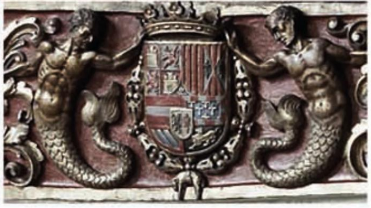
▲ ROWING BENCH AND OAR
The most experienced oarsman took the inner seat and dictated the timing of the strokes to the other three oarsmen, who pulled on the battens.

▲ THE BINDING OF THE OARS
The beechwood oars were 11.2m (37ft) long. Oars made from a single piece of wood were more likely to break, so they were usually made from two lengths bound together.

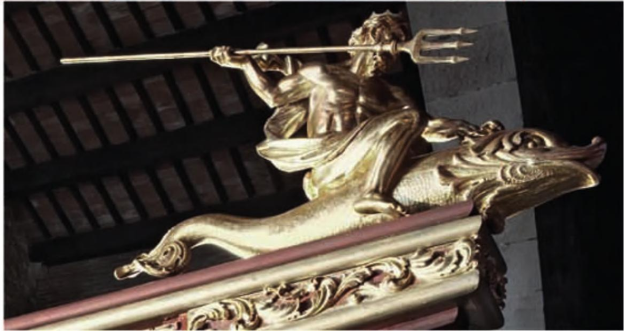
◄ FRONT VIEW
The forecastle housing the main cannons lay behind the long prow.

▼ THOLE PIN
Each oar pivoted around a peg called a thole pin as the oarsmen drove its blade into the water. The oar was simply tied to the pin with a loop of rope.

► COAT OF ARMS
The *Galera Real* was a gift to Don John from King Philip II of Spain, his half-brother. The prow is decorated with the king's coat of arms, supported by two mermen.

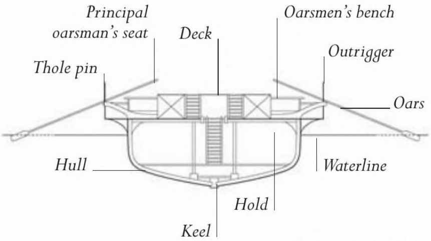


► CLASSICAL FIGUREHEAD
The prow ends in a magnificent figurehead of a gilded Neptune, the Roman god of the sea, who is shown riding on a dolphin and brandishing a trident. The prow of the original ship was removed before Lepanto.



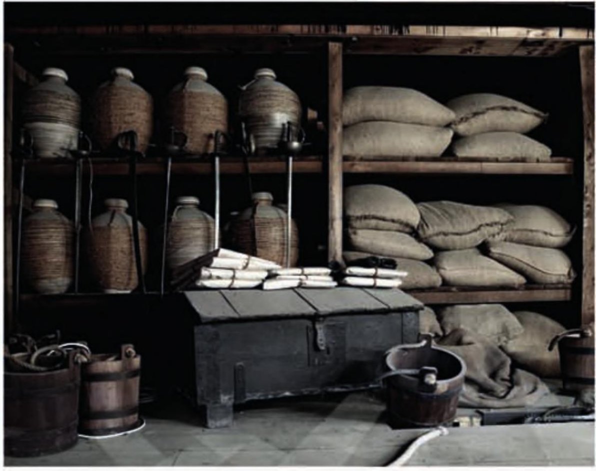
STERN, POOP, AND HOLD

The ship's most striking feature is its ornate stern. This was painstakingly recreated from a contemporary description. Although elaborately decorated, the poop deck became the centre of resistance if the galley was boarded in battle, with fighting men clustering there to defend their flag and commander. The *Galera Real* had a larger hold than ordinary war galleys, with plenty of space for stores.



CROSS-SECTION

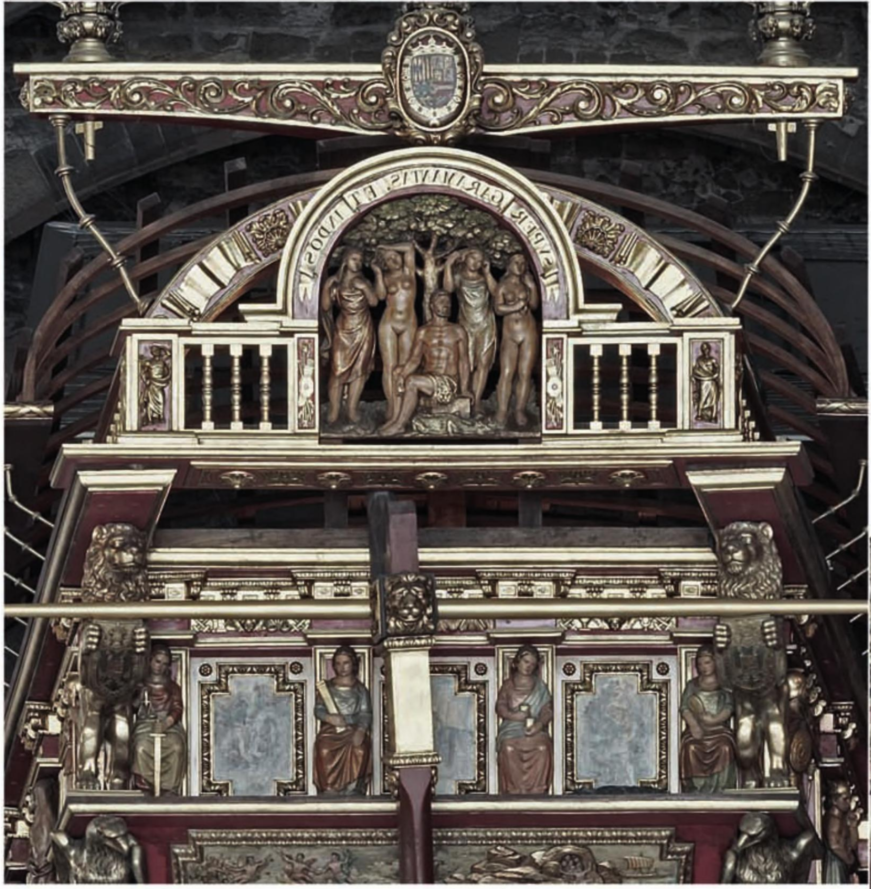
GALLEY HOLD



▲ SPACIOUS HOLD
The hold stored food, drink, weapons, armour, sailcloth, spars, clothing, ropes, and a number of lockable chests in which the ship's gentlemen kept their possessions. There was also a gunpowder room and a surgery.

▲ BASIC STORES
Grain, wine, and water were always in store. Fresh vegetables and bread were taken aboard whenever possible.

GALLEY STERN



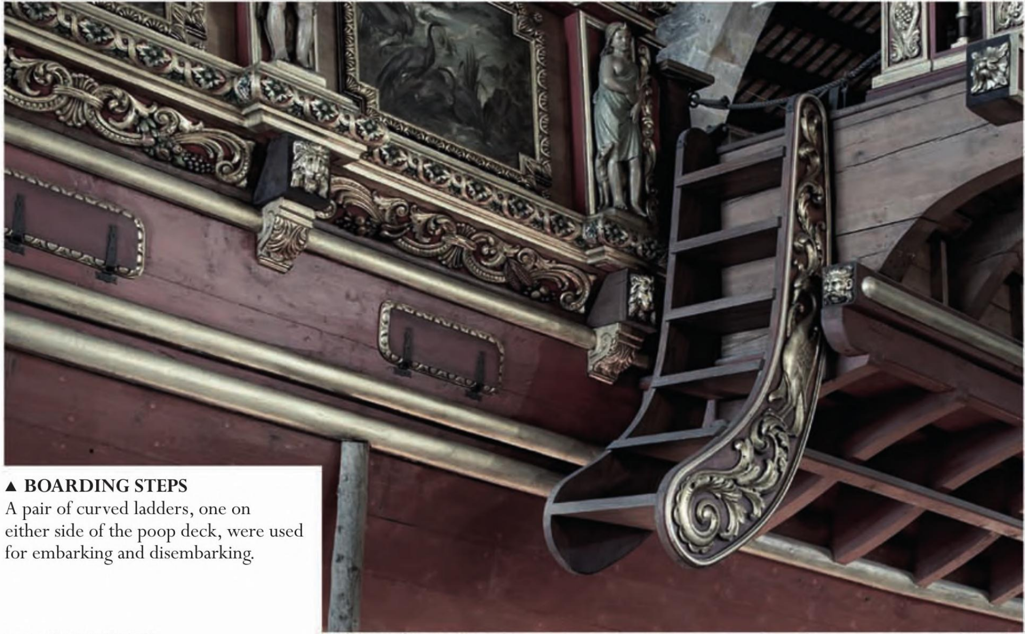
▲ DECORATED STERN
The *Galera Real* was built in Barcelona in 1568 and decorated in Seville. The frieze at the top of the stern shows Hercules in the Garden of the Hesperides. Below, the two lions hold the coats of arms of Austria and the Order of the Golden Fleece, while the four female figures represent Christian virtues.

▶ GILDED BALUSTER
Every tiny detail around the stern, where the admiral resided in the poop, is richly carved and gilded or painted.

▶ EAGLE
The gilded eagles on the stern are a reference to the Roman Empire and Christian Europe's desire to win back Rome's former lands from Ottoman control.

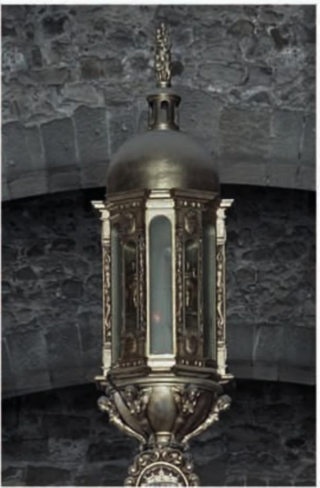
◀ FACE OF MEDUSA
The snake-headed gorgon Medusa stares out from the stern of the *Galera Real*, deflecting evil and bringing destruction on the ships of Don John's enemies.

POOP DECK

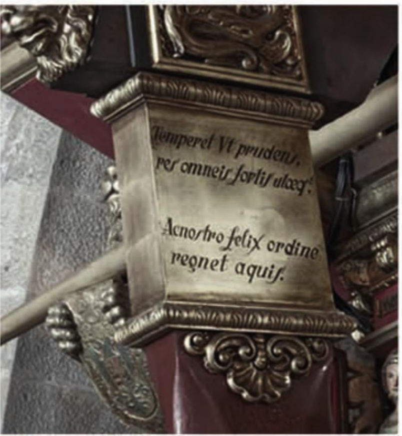


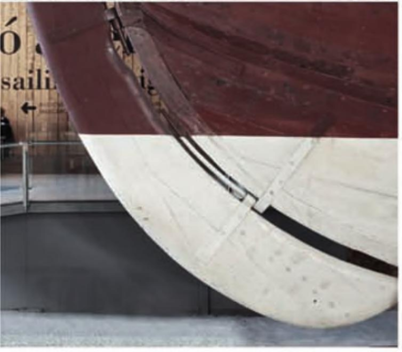
▲ BOARDING STEPS
A pair of curved ladders, one on either side of the poop deck, were used for embarking and disembarking.

▼ NIGHT LIGHT
Above the helmsman's position on the poop deck are three large, ornate lanterns. They were used as beacons for keeping the fleet together at night.

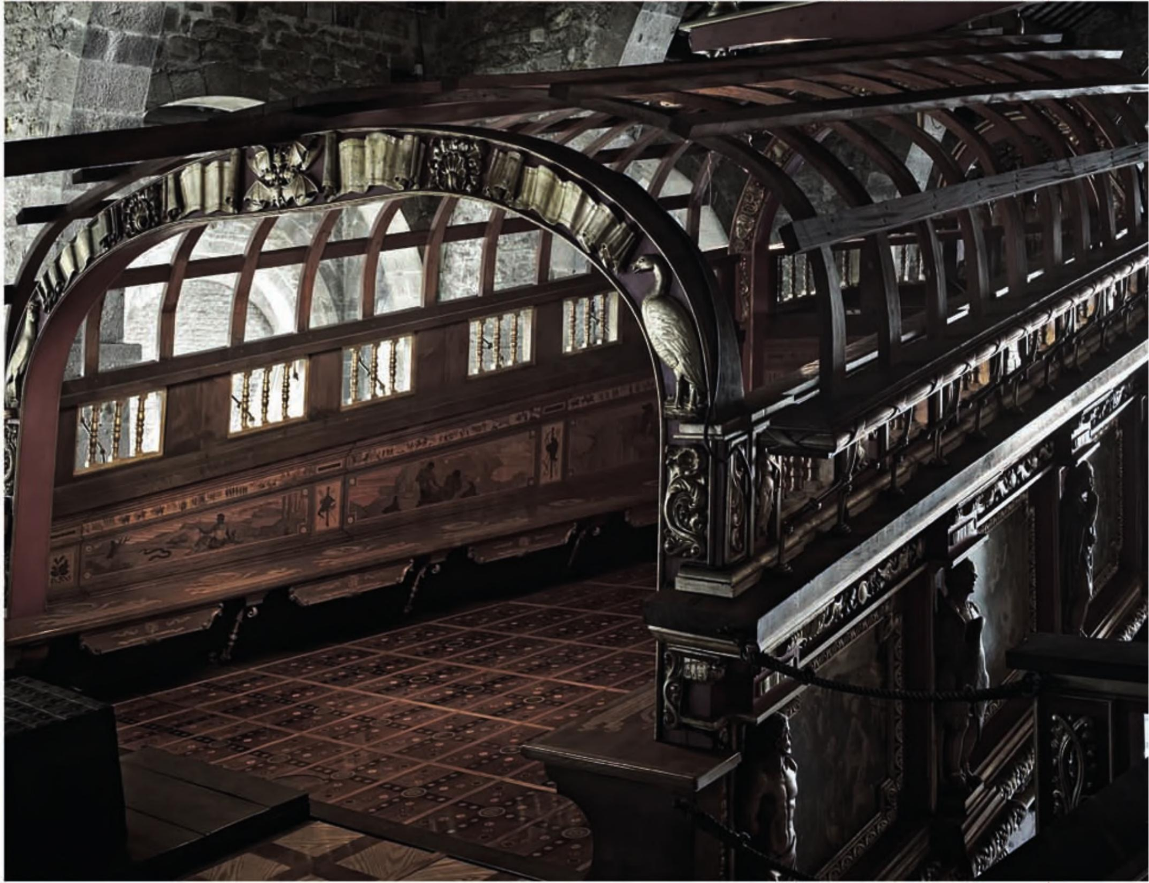


▼ LATIN MOTTO
The rudder's inscription extols prudence and strength – virtues needed to rule the waves.





▲ RUDDER
Galley rudders were smaller than those on sailing ships, and curved rather than straight.



▲ POOP DECOR AND CANOPY
The backrests of the benches depict episodes from Greek myths, most of which have a nautical theme and a moral message. An awning was draped over the canopy to keep out the sun, wind, and rain, and to give protection in battle.

GALLEY WARFARE

THE BATTLE OF LEPANTO

Fought off the coast of Greece on 7 October 1571, the Battle of Lepanto was the climax of the era of galley warfare in the Mediterranean. More than 400 oared warships engaged in a close-fought battle that resulted in one of Christian Europe's greatest victories over the Ottoman Turks.

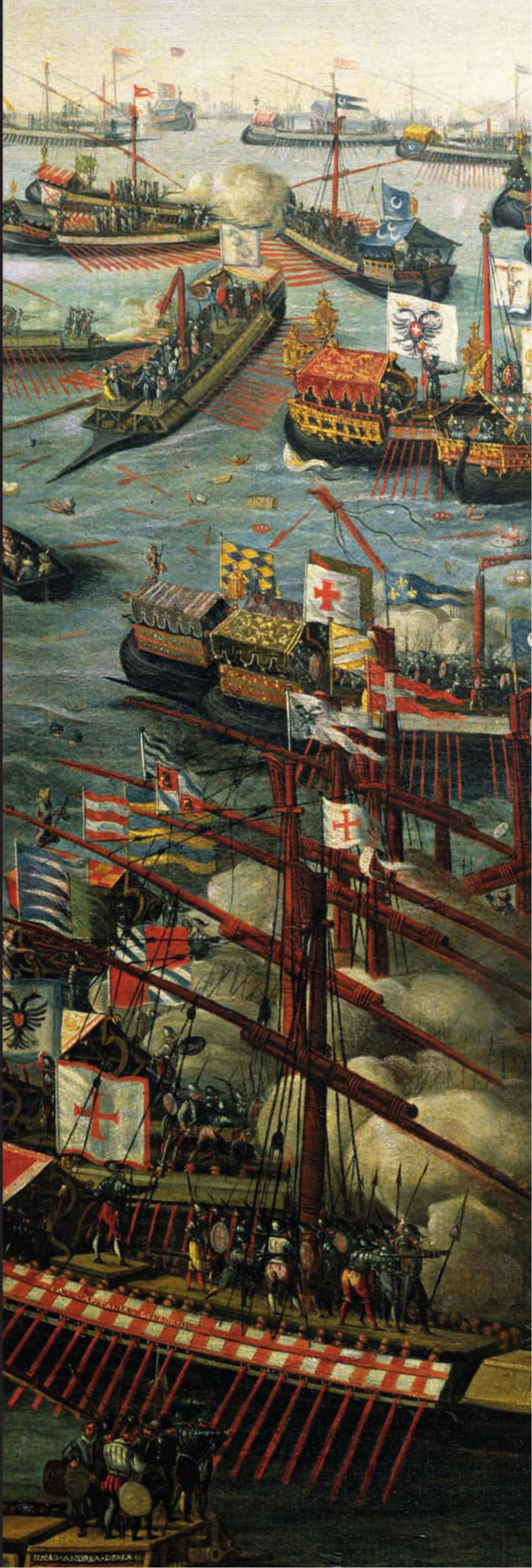
In the 16th century, Muslim naval forces – the well-funded fleet of the Ottoman Empire, and the piratical Barbary corsairs from the ports of North Africa – were bidding for control of the Mediterranean. The states of Christian Europe were rarely capable of uniting to face this threat; however, in 1571, they forged a Holy League to resist an Ottoman attack on Cyprus. The combined fleets of Habsburg Spain, Venice, Genoa, the Papacy, Savoy, and the Knights of St John were led by Don John of Austria, illegitimate half-brother of Philip II of Spain. Heading into the eastern Mediterranean, they met the Ottoman fleet and its corsair allies in the Gulf of Patras.

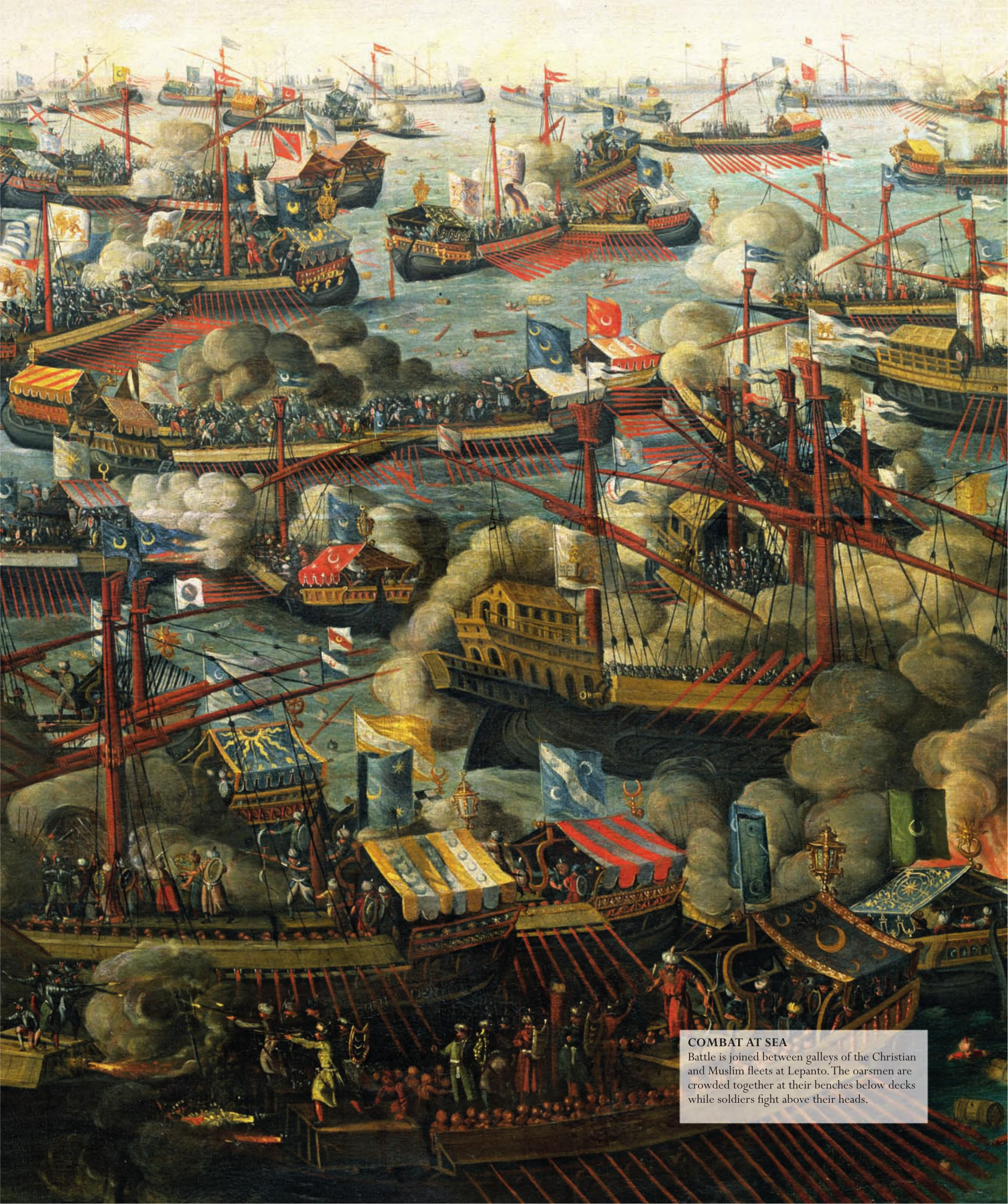
The galleys carried large contingents of soldiers, but their use of equipment showed a clear division of technology and approach. The Christian forces were mostly armoured and carrying arquebuses, while the Muslims were more lightly clad and equipped with composite bows. Galley battles had traditionally involved engaging enemy ships so that soldiers could board and attack at close quarters. But now the Christian fleet also depended heavily on the firepower of naval guns: their galleys had cannon in the bows, and smaller swivel guns to sweep an enemy's deck. They had also rebuilt six large Venetian cargo ships as "galleasses" – unwieldy gun platforms heavily armed with cannon, which had to be assisted into action in front of their fleet. The Muslim galleys, meanwhile, were smaller and lighter, and depended on speed of manoeuvre to gain advantage; on the Christian side, only the Venetian galleys, oared by free men, could move just as nimbly. The rest of Don John's galleys, heavy with cannon and clumsily rowed by prisoners and slaves, kept in line abreast, to protect their flanks and maximize the power of their forward-firing guns.

JOINING THE FRAY

Commanded by Ali Pasha from the flagship *Sultana*, the Ottomans and corsairs took the initiative. They advanced in crescent formation, attempting to outflank the Venetians on their left, and the Genoese on their right. The Ottoman centre came under bombardment from the galleasses, causing damage to the ships. Ali Pasha, undeterred, pressed forward towards Don John's flagship *Real* at the heart of the Christian fleet. Soon galleys were locked together in deadly combat, soldiers fighting hand-to-hand on the decks. The Genoese were outflanked by corsair captain Uluj Ali, who threatened to break through on the Christian right. On the left, the Venetian commander Agostino Barbarigo was killed by an arrow in the eye, while in the centre Ottoman Janissaries boarded *Real*.

The Christians were saved by the experienced Habsburg admiral Álvaro de Bazán. Leading a reserve force of galleys, he directed ships into the battle at crucial moments, shoring up the flanks and rescuing Don John's flagship. The turning point came when Ali Pasha's flagship *Sultana* was boarded and taken, and his severed head displayed on a pike. The Muslim fleet disintegrated, with only Uluj Ali succeeding in rescuing his ships from the rout.

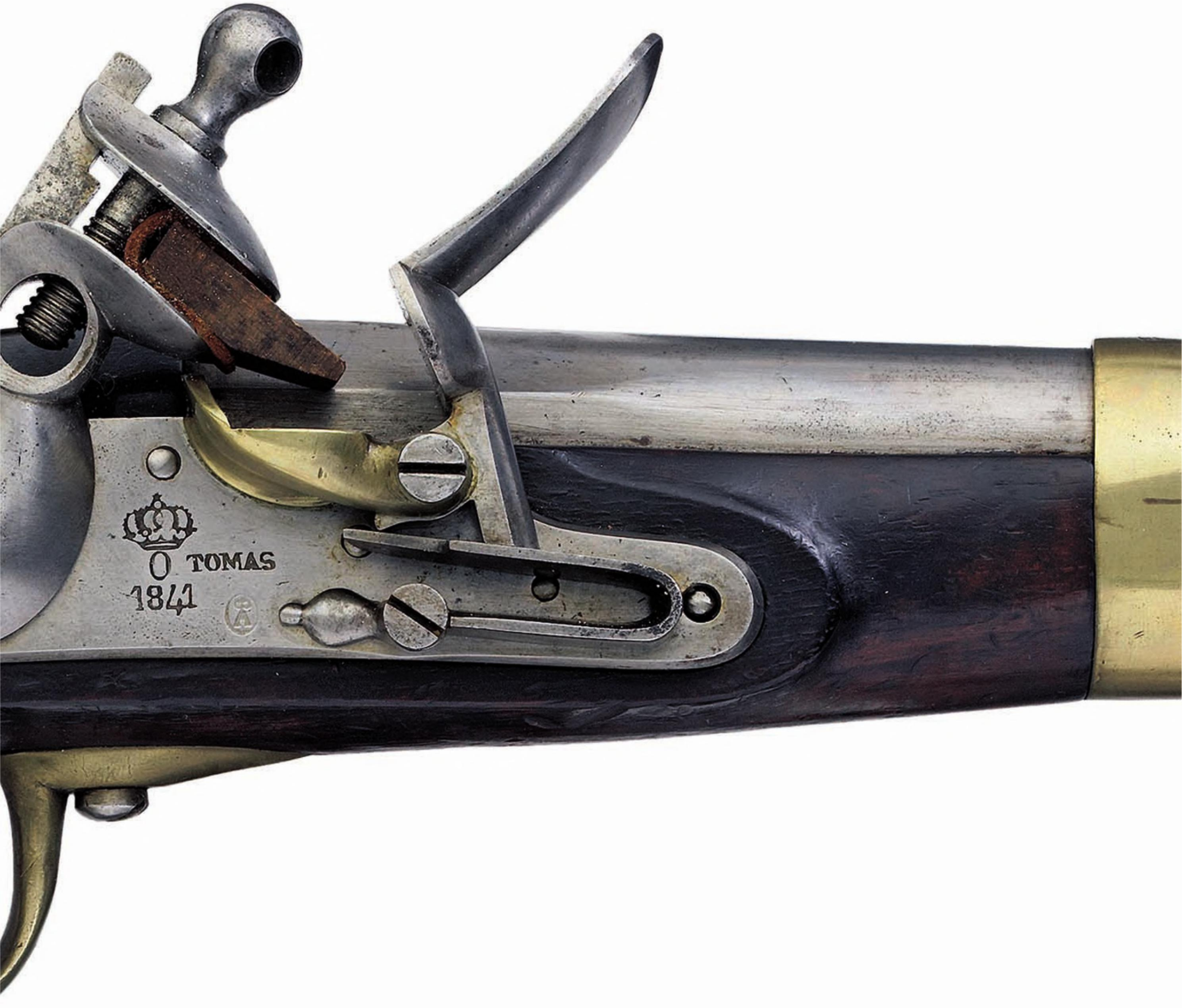




COMBAT AT SEA
Battle is joined between galleys of the Christian and Muslim fleets at Lepanto. The oarsmen are crowded together at their benches below decks while soldiers fight above their heads.

1680–1815

FLINTLOCK AND BAYONET


0 TOMAS
1841

INTRODUCTION

From the late 17th to the early 19th centuries, there were few dramatic changes in military technology. The basic infantry weapon was the flintlock musket with bayonet attached; artillery consisted of smoothbore muzzle-loading cannon. However, the nature of warfare developed in organization, ideology, strategy, and tactics.

Eighteenth-century European states maintained permanent armies commanded by officers, with regiments and formal hierarchies of rank. Infantry were uniformed and issued with standard equipment, harshly disciplined, and drilled to march and fight in formation with automatic obedience. Cavalry performed a variety of roles, from reconnaissance to charges or pursuit of the enemy, while field artillery was also now a key part of armies. At sea, a ship of the line might mount 70–130 cannon in broadside. Thus, non-European states, such as Ottoman Turkey or Indian princedoms, found themselves at a military disadvantage.

From the second half of the 18th century, a new spirit infused European warfare, related to the currents of revolution that swept America in the 1770s, and France from 1789. Although the War of Independence, waged by America against Britain, was fought mostly by conventional armies, irregular troops with rifles showed their effectiveness. This encouraged European armies to make better use of skirmishers as an adjunct to their line infantry, and to arm some of their forces with rifles. In 1793, the French revolutionary government created a mass national army, based on the idea that men should fight due to patriotic enthusiasm, rather than fear of punishment. After rising to power in 1799, Napoleon Bonaparte reorganized the French army into a unified force of four corps, each capable of independent operations. Like the British Royal Navy's Admiral Nelson, at sea Napoleon favoured an offensive strategy and aggressive tactics. By 1815, European armies had grown to unprecedented size and states had shown an ability to mobilize vast resources for victory in war.

KEY DATES

1680

1683 The Siege of Vienna, Austria, fails, marking the last Ottoman threat to Europe

1692 The Siege of Namur exemplifies highly formalized siege warfare

c.1700 The flintlock musket and socket bayonet become standard issue for European armies

1704 Britain's Duke of Marlborough wins his greatest victory over the French, at Blenheim, Germany

1709 A Russian victory over Sweden, at Poltava (in modern Ukraine) signals Russia's new status as a major military power

1713–40 King Frederick William I turns Prussia into a militaristic state

1720 Manchu China conquers Tibet

1739 In India, Iranian ruler Nadir Shah defeats a Mughal army and sacks Delhi

1740s Iron ramrods and paper cartridges improve musket loading and rate of fire

1745 The Battle of Fontenoy, in Belgium, exemplifies European musket-and-bayonet tactics

1756–63 The Seven Years' War is fought in Europe – sometimes regarded as the first "world war"

1757 Frederick the Great of Prussia beats the French-Austrian allies, at Rossbach and Leuthen (in Saxony and Poland respectively)

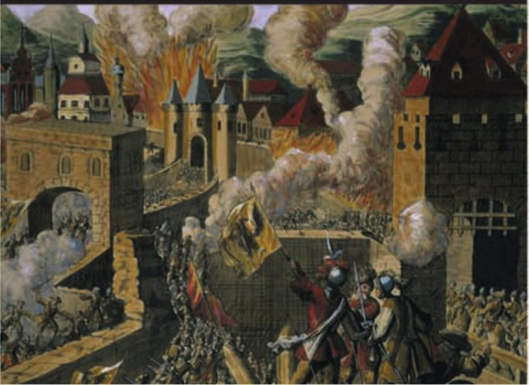
1759 Victory at the Battle of Quebec gives Britain control of Canada

1763 The French navy adopts signal flags for improved communication at sea

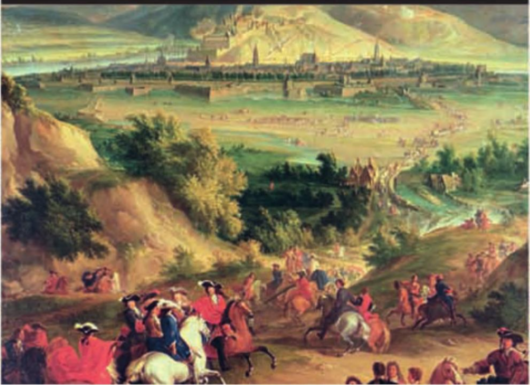
c.1770 The carronade, a short-range British naval gun, is introduced

1775–83 American rebels, with French support, defeat the British in the American Revolutionary War

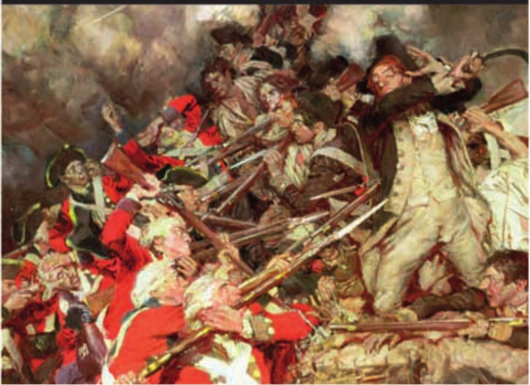
THE SACK OF MAGDEBURG – 1631



THE SIEGE OF NAMUR – 1692



THE BATTLE OF YORKTOWN – 1781



1776 The Americans use a submersible, the Turtle, to attack British ships, at Boston

1776 Jean-Baptiste Gribeauval reforms French artillery, introducing standardized calibres

1780 In India, the army of Hyder Ali, ruler of Mysore, uses iron-cased rockets against the British

1791 The Chappe semaphore telegraph system is invented

1792 The French Revolutionary Wars begin, pitting the French Republic against European monarchies

1793 France creates a revolutionary citizen army through the "levée en masse"

1794 An observation balloon is used by the French at the Battle of Fleurus, Belgium

1798 Nelson destroys a French fleet at Aboukir Bay, in the Battle of the Nile

1803 The British Army adopts shrapnel shells

1805 Napoleon defeats Russia and Austria at Austerlitz

1805 The French and Spanish fleets are defeated by the British at Trafalgar

1807 The British use Congreve rockets in an attack on Copenhagen, Denmark

1808 The Spanish start a guerrilla war against French occupation forces

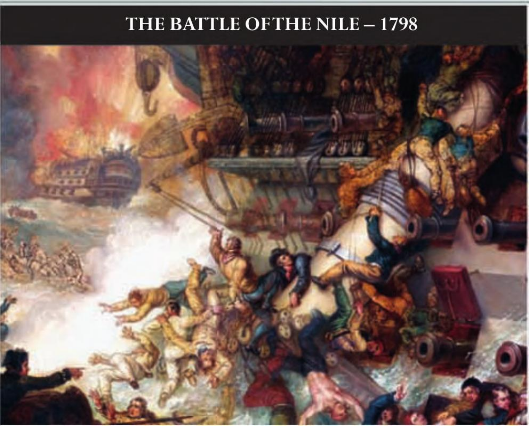
1812 Invading Russia, Napoleon loses most of his army in a winter retreat from Moscow

1812–15 The US fights a war with Britain

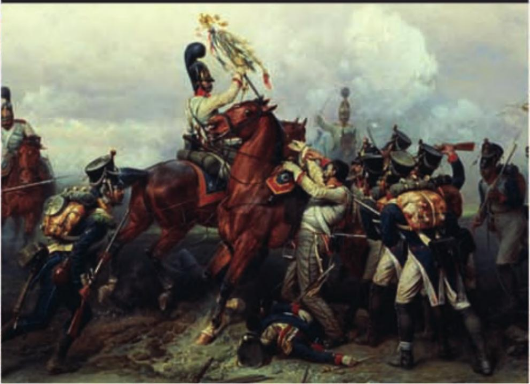
1815 Napoleon is defeated by British and Prussian armies at the Battle of Waterloo

1815

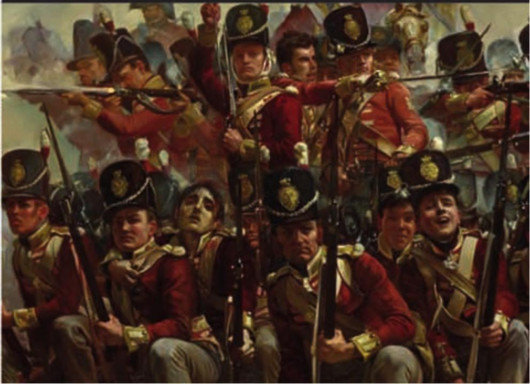
THE BATTLE OF THE NILE – 1798



THE BATTLE OF AUSTERLITZ – 1805



THE BATTLE OF WATERLOO – 1815



KEY DEVELOPMENT

18TH-CENTURY UNIFORMED ARMIES

The armies that fought such conflicts as the wars of the Spanish Succession (1701–14) and Austrian Succession (1740–48), the Seven Years' War (1756–63), and the American Revolutionary War (1775–83), followed the tradition of uniformed regular forces, with a formal hierarchy of ranks.

Permanent regiments, identified by banners, uniforms, and other symbols, provided a focus for loyalty. Cavalry retained high status and were given important tasks: light horsemen carried out reconnaissance and raids, while heavy cavalry were used in field battles to charge with sabres drawn. Although field artillery was growing in use, muzzle-loaded smoothbore cannon as yet played only a supporting role. Consequently, the success or failure of an army depended mainly upon its infantry.

MUSKETS AND RIFLES

Around the start of the 18th century, European infantry adopted the flintlock musket and socket bayonet. The bayonet replaced the pike, in effect making every foot soldier a musketeer. Usually recruited from the lowest levels of society, infantry were subject to brutal discipline and relentlessly drilled to execute orders without question. They were trained to manoeuvre with mechanical precision, marching in columns and deploying in lines for combat, to bring maximum firepower to bear. Since armour was no longer used, soldiers walked unprotected into enemy muskets and cannon, while maintaining close formation. They shot their muskets in controlled volleys, relying on volume of fire rather than individual marksmanship.

Alongside the line infantry, European armies deployed light infantry, who were supposed to take on a freer role. Some of these light troops, notably the Austrian and Prussian Jäger, were armed with rifles. Line infantry were not trained in aimed fire, which was hardly possible with the inherently inaccurate smoothbore musket. The Jäger were accomplished sharpshooters, however, capable of accurate sniping and skilled in the use of cover. Elsewhere, rifle-armed American frontiersmen gained a legendary reputation for success against the British Army in the American War of Independence, although the reality was not as clearly defined.

HEAVY LOSSES

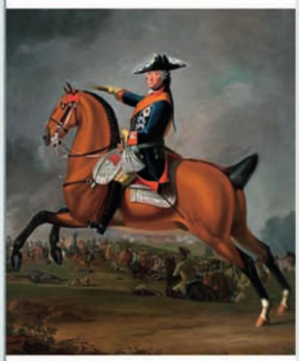
The level of combat casualties during this period was often astonishingly high. At the Battle of Zorndorf in 1758, during the Seven Years' War, the Prussians suffered 11,000 casualties out of an army of 36,000, while the Russians lost 22,000 men out of 43,000. Commanders such as Frederick the Great aspired to battles of sweeping manoeuvre, making coordinated use of infantry, cavalry, and artillery to achieve victories. Some battles, however, simply degenerated into incoherent mêlées, obscured by great clouds of gunpowder smoke. Although many European armies had developed into highly efficient killing machines, commanders typically found it difficult to translate successes on the battlefield into permanent strategic gains.

KEY **FIGURE**

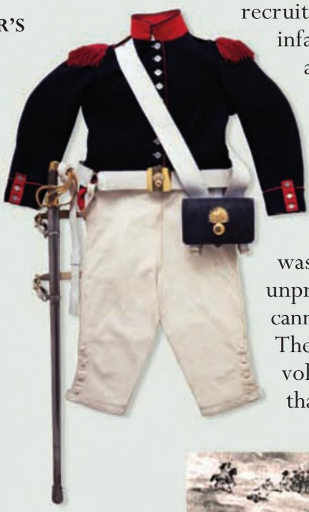
FREDERICK THE GREAT

1740–86

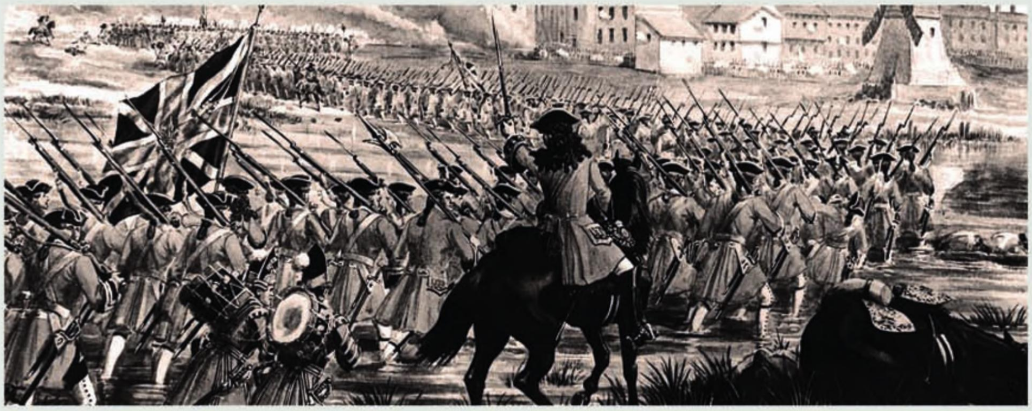
Frederick the Great (Frederick II, King of Prussia) was the most admired commander of his time. His greatest battles were at Rossbach and Leuthen, in November and December, 1757, during the Seven Years' War. He won each victory against far larger forces, through aggressive battlefield manoeuvres.



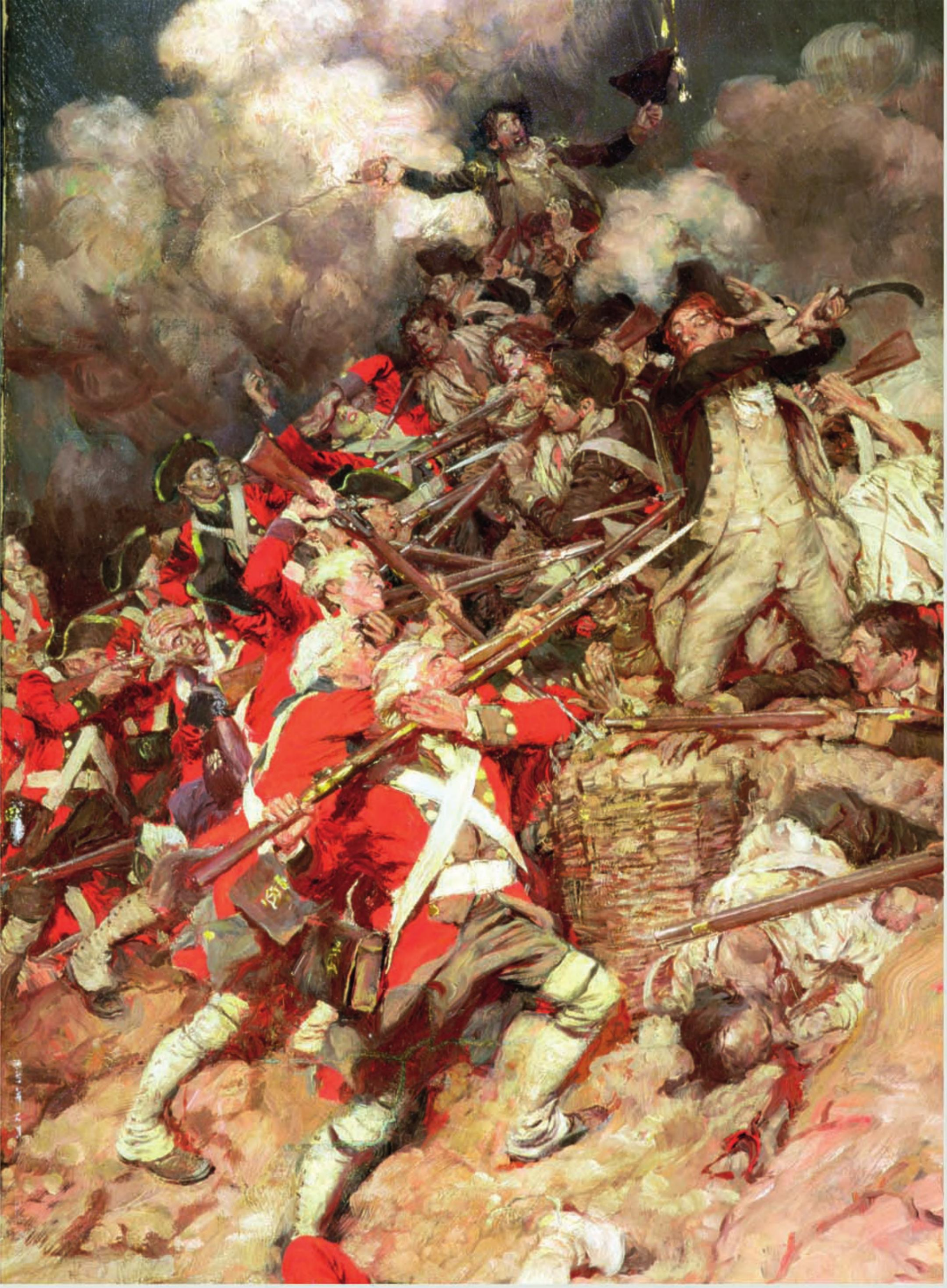
▲ Frederick commanded his army in person, priding himself upon his tactical handling of artillery, cavalry, and the disciplined Prussian infantry.



▶ **CUIRASSIER'S UNIFORM**
Cuirassiers were French heavy cavalry who wore plumed helmets. Their tunics were less spectacular than those of the light cavalry, but they were usually covered by armour – a cuirass and back plate.



▶ **THE BATTLE OF BLENHEIM**
A British army led by the Duke of Marlborough, and Austrian forces under Eugene of Savoy, defeated Franco-Bavarian forces at Blenheim, in 1704, during the War of Spanish Succession. More than 30,000 soldiers were killed or wounded in the day's fighting.



◀ **THE BATTLE OF YORKTOWN**
The final battle of the American Revolutionary War, in 1781, set American troops and their French allies against British redcoats. Although the Americans made fun of the formality of the British, they created their own disciplined, uniformed army to fight the war.

> “If my soldiers were **to begin to think**, not one would **remain in the army**”
>
> **FREDERICK THE GREAT (FREDERICK II, KING OF PRUSSIA)**, c.18TH CENTURY

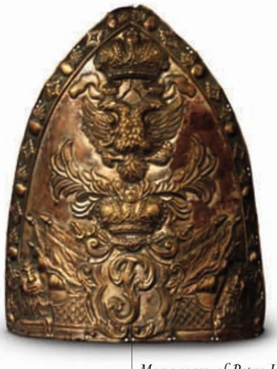
KEY **EVENTS**

1700–1800

- **c.1700** European armies abandon the pike and adopt the socket bayonet, which fits over the barrel of a flintlock musket.
- **1713–40** By employing draconian punishments, King Frederick William I of Prussia transforms the Prussian army into Europe’s most rigorously disciplined military force.
- **1740s** Ramrods made of iron, rather than wood, and cartridges (paper containers that combine both ball and powder) are introduced. These innovations improve the speed of musket loading – and also rates of fire.
- **1744** Frederick the Great of Prussia, the son of Frederick William I, recruits Jäger (huntsmen) as light rifle-armed troops in the Prussian army.
- **1775** American commander-in-chief George Washington creates the Continental Army, a European-style uniformed force armed with muskets, to fight against the British during the American War of Independence.
- **1776** General Jean Baptiste de Gribeauval initiates a major reform of French artillery, introducing standardized sizes and lighter gun carriages to improve mobility.

UNIFORMS OF EUROPEAN ARMIES

European military uniforms of the 18th century generally took the form of a tricorn hat, a waistcoat, breeches, canvas gaiters, and a coat with a long skirt. Infantrymen wore coats in national colours – blue for the Prussians, green for the Russians, and red for the British. One notable component of uniform was the elongated, brimless grenadier's cap. The grenadiers were established in the mid- to late 1600s as an elite infantry unit of the tallest and strongest men, who attacked with heavy grenades from the front rank of the infantry. They chose a brimless cap to enable them to sling their musket over their shoulders and throw grenades more easily.



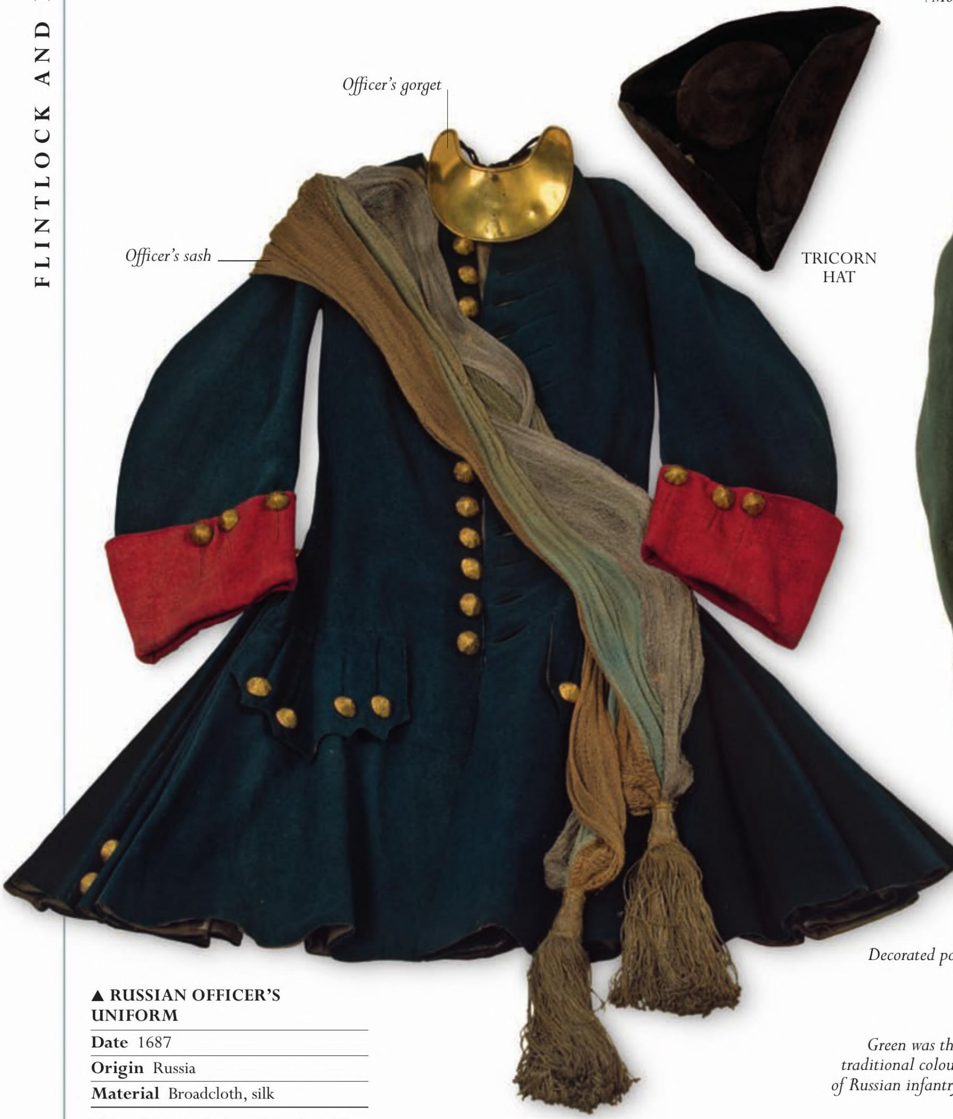
◀ RUSSIAN GRENADIER'S CAP

Date 1762

Origin Russia

Material Silvered brass

The silvered-brass front plate on this grenadier cap bears the monogram of the Russian Emperor Peter III. After a reign of just six months in that year, he was succeeded by his wife, Catherine II ("Catherine the Great").



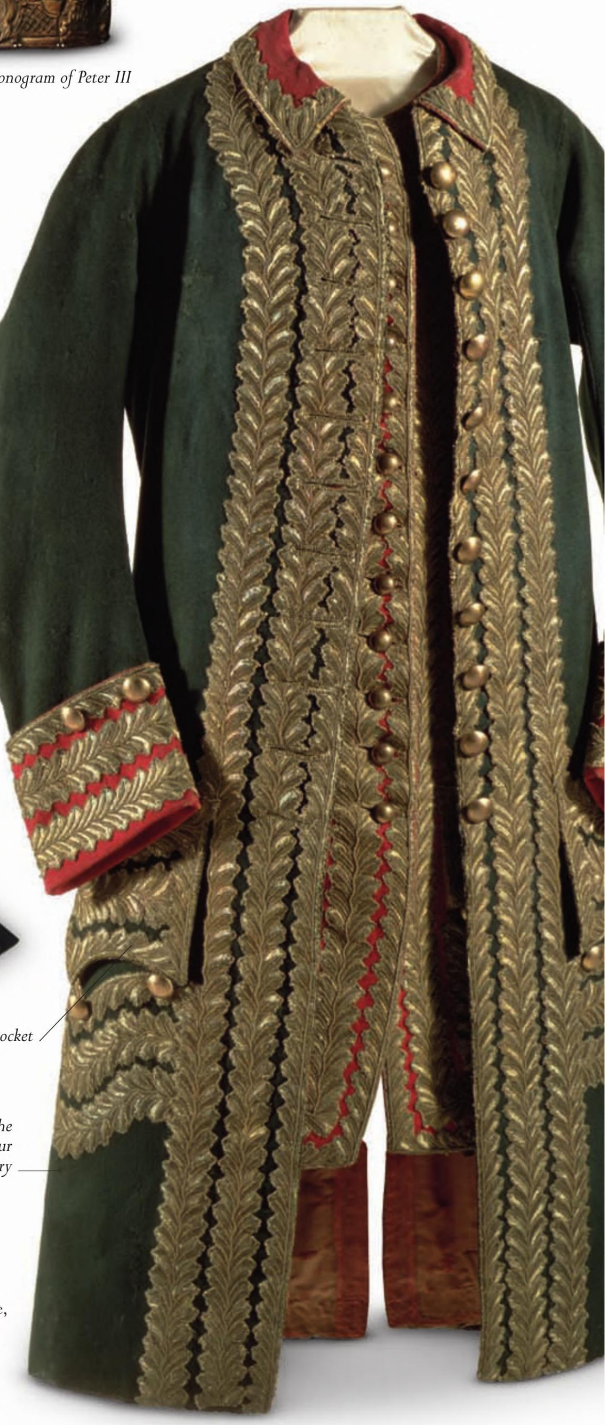
▲ RUSSIAN OFFICER'S UNIFORM

Date 1687

Origin Russia

Material Broadcloth, silk

This uniform and tricorn hat of an officer in the elite Preobrazhensky Regiment of the Russian army was worn by Peter I ("Peter the Great"), who established the regiment in 1687. The regiment had significant success against Swedish forces in the Great Northern War of 1700–21, and later formed the bodyguard of Empress Catherine the Great.



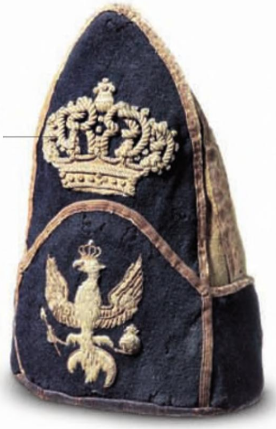
▶ RUSSIAN GENERAL'S UNIFORM

Date 1760

Origin Russia

Material Wool, silk

This ornate uniform belonged to the Russian general Alexander Suvorov, who never lost a battle in his entire career. Shortly before his death in 1800 he was made Generalissimo of the Russian Empire, taking command of all Russian troops, following his masterminding of a tactical retreat across the Alps in 1799.



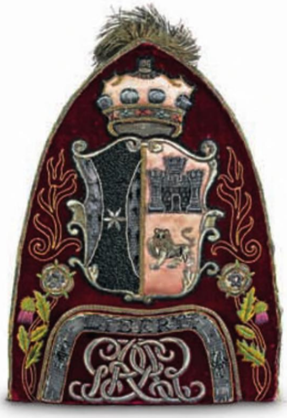
◀ PRUSSIAN GRENADIER'S CAP

Date 1713

Origin Prussia

Material Wool

This cap was worn by grenadiers in the infantry regiment of Frederick Henry, Margrave of Brandenburg-Schwedt, in 1713. At the time, Henry was just four years old and under the guardianship of his uncle, Frederick I.



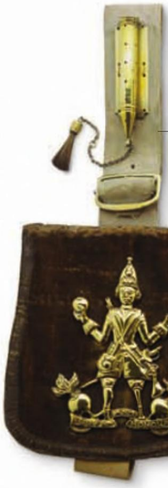
▶ GRENADIER'S POUCH

Date 1750

Origin England

Material Leather, brass

Grenadiers carried leather pouches containing essential equipment for use on the battlefield. The brass facing depicts a grenadier wearing a tall cap, which made him look even more imposing to enemy forces.



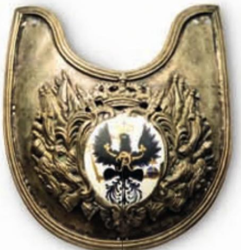
▶ PRUSSIAN OFFICER'S GORGET

Date 1750

Origin Prussia

Material Brass

In the 18th and 19th centuries, army officers wore gorgets – a metal collar originally designed to protect the throat – as a symbol of their rank.



▲ BRITISH GRENADIER'S CAP

Date 1746

Origin England

Material Wool

This cap for an officer in the Norwich Company of Artillery bears the personal coat of arms of Sir John Hobart. He raised the company in 1746 to defend the city in the event of attack during the Jacobite Rebellion.

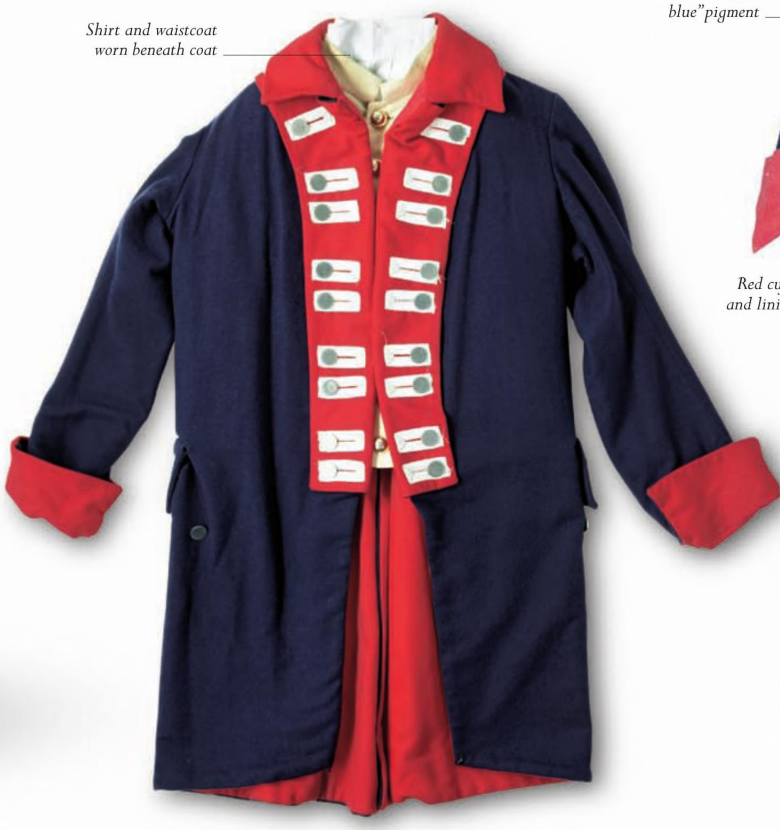
▼ PRUSSIAN INFANTRY UNIFORM

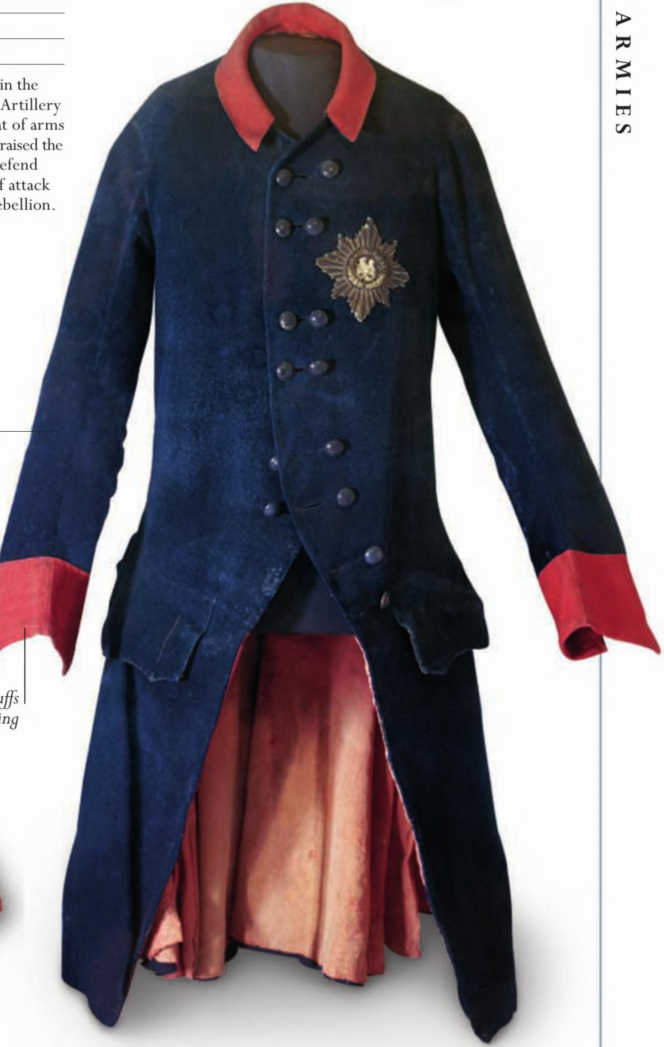
Date 1740

Origin Prussia

Material Wool

The infantrymen in the Prussian army under Frederick II ("Frederick the Great") wore long, dark blue coats with red facings and lining. They fought with flintlock muskets and were fiercely disciplined and highly trained.





▲ MILITARY GREATCOAT OF FREDERICK THE GREAT

Date 1760

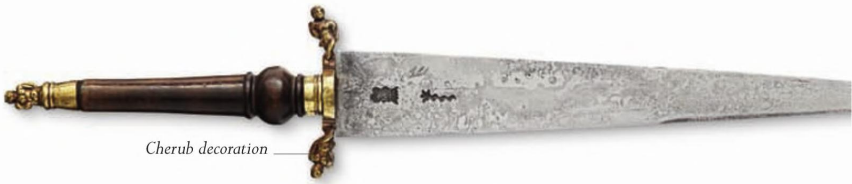
Origin Prussia

Material Wool

Frederick the Great (see p.160) often led the Prussian army in person and frequently dressed in a simple blue military uniform and greatcoat. Frederick was widely praised for his battlefield tactics – in fact, Napoleon Bonaparte regarded Frederick as the greatest military tactician in history.

PLUG, SOCKET, AND SWORD BAYONETS

Infantrymen fighting with muskets were vulnerable to enemy attack while loading their weapons after firing, so originally fought alongside pikemen for protection. At the end of the 17th century, bayonets were developed to enable musketeers to defend themselves. The first type, plug bayonets, were daggers thrust into the musket's muzzle. They had to be removed to fire the weapon, and were superseded by socket bayonets, which were attached by a metal tube that engaged with a stud on the gun's barrel. In the early 19th century, many armies issued the longer sword bayonet, which could be removed from the gun and used in hand-to-hand combat.

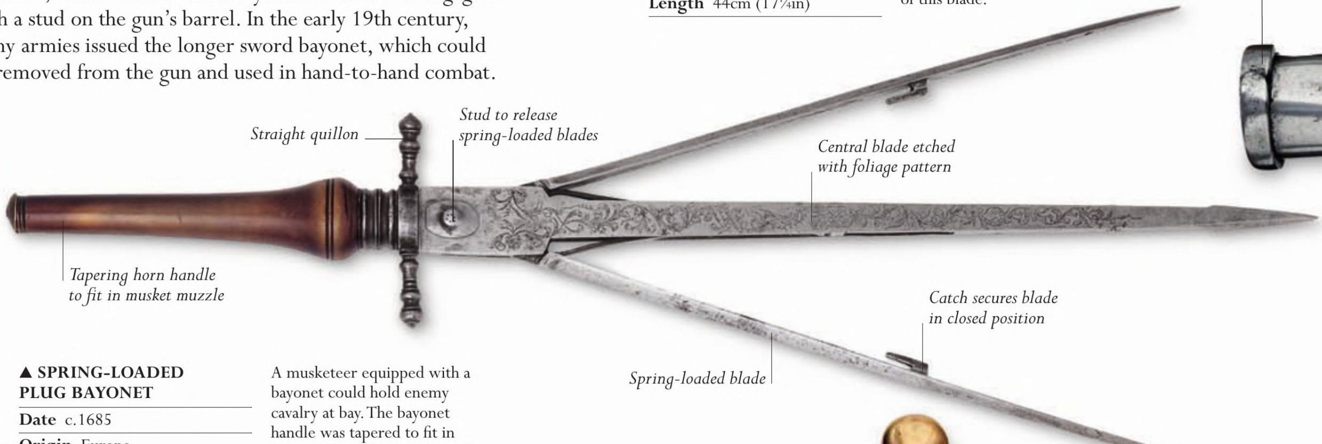

Cherub decoration

▲ ENGLISH OFFICER'S PLUG BAYONET

Date c.1680
Origin England
Weight 600g (21oz)
Length 44cm (17¼in)

In addition to being weapons, bayonets could be removed from the gun and used for practical tasks. Officers' bayonets might also have ornate features, such as the cherubs on the handle of this blade.

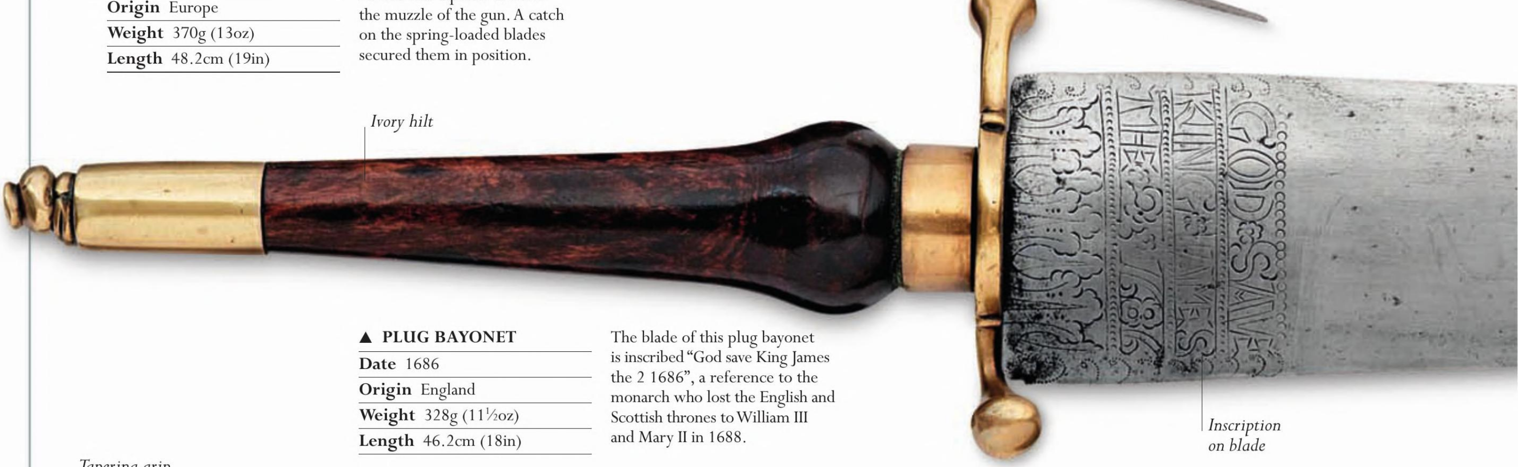
Collar of socket


Straight quillon
Stud to release spring-loaded blades
Central blade etched with foliage pattern
Tapering horn handle to fit in musket muzzle
Catch secures blade in closed position
Spring-loaded blade

▲ SPRING-LOADED PLUG BAYONET

Date c.1685
Origin Europe
Weight 370g (13oz)
Length 48.2cm (19in)

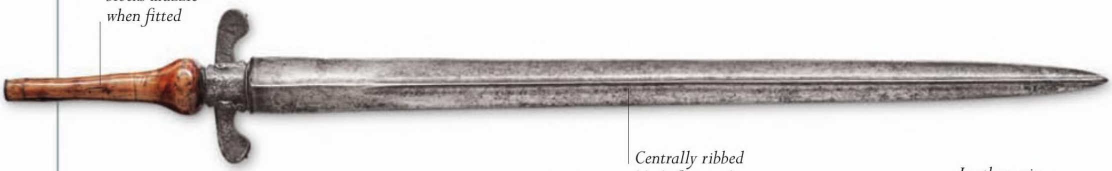
A musketeer equipped with a bayonet could hold enemy cavalry at bay. The bayonet handle was tapered to fit in the muzzle of the gun. A catch on the spring-loaded blades secured them in position.


Ivory hilt
Inscription on blade

▲ PLUG BAYONET

Date 1686
Origin England
Weight 328g (11½oz)
Length 46.2cm (18in)

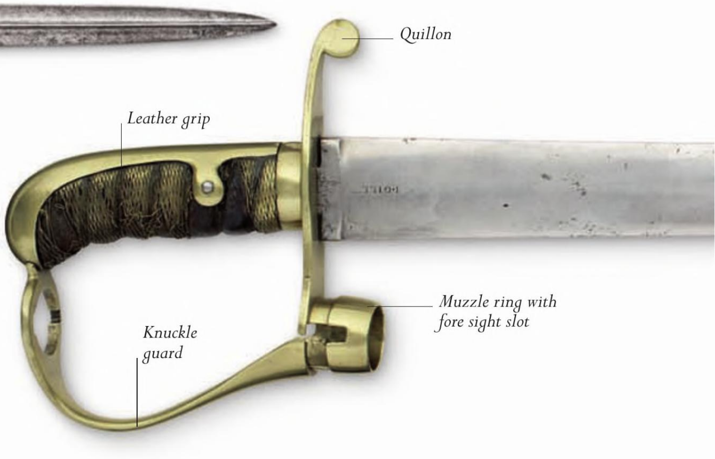
The blade of this plug bayonet is inscribed "God save King James the 2 1686", a reference to the monarch who lost the English and Scottish thrones to William III and Mary II in 1688.

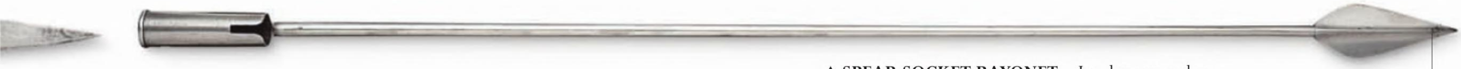

Tapering grip blocks muzzle when fitted
Centrally ribbed blade for rigidity

▲ OFFICERS' PLUG BAYONET

Date 1695
Origin England
Weight 700g (24¾oz)
Length 64cm (25in)

This type of bayonet had to be fitted into a gun barrel before use. English Royalist troops were defeated by charging Highlanders at the Battle of Killiecrankie, Scotland, in 1689, because they were too slow to mount their plug bayonets in the heat of battle.

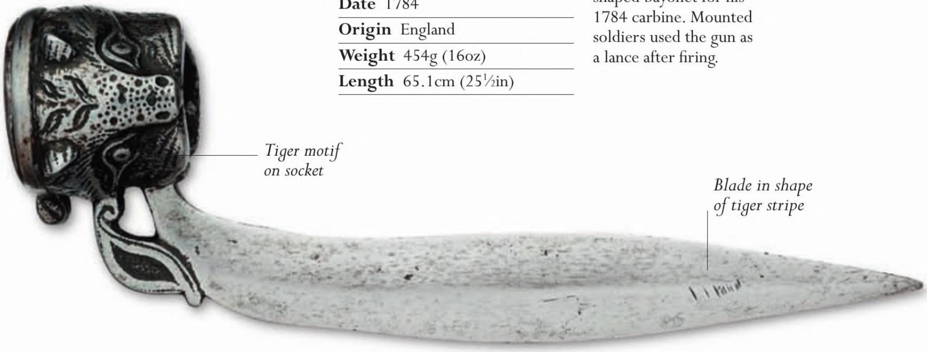

Quillon
Leather grip
Muzzle ring with fore sight slot
Knuckle guard


Spear point

▲ SPEAR SOCKET BAYONET FOR EGG'S CARBINE

Date	1784
Origin	England
Weight	454g (16oz)
Length	65.1cm (25½in)

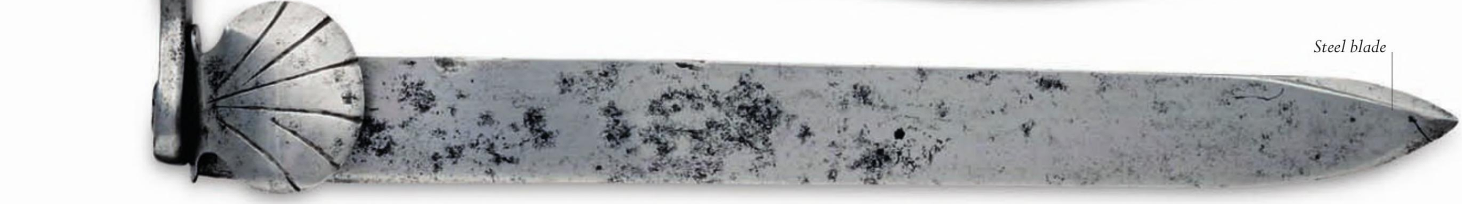
London gun-maker Durs Egg made this spear-shaped bayonet for his 1784 carbine. Mounted soldiers used the gun as a lance after firing.


Tiger motif on socket
Blade in shape of tiger stripe

▶ TIGER BAYONET (SANGIN)

Date	c.1785
Origin	India
Weight	829g (29¼oz)
Length	14.4cm (5¾in)

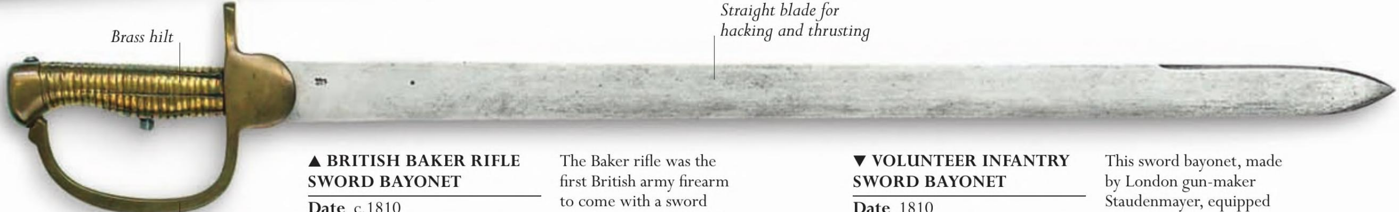
The socket of this bayonet represents a tiger's head. It is from the arsenal of Tipu Sultan, "the Tiger of Mysore", ruler of Mysore in southern India from 1782 to 1789.


Steel blade

▲ SOCKET BAYONET

Date	c.1790
Origin	England
Weight	454g (16oz)
Length	33cm (13in)

The socket bayonet, which was first used by the French army in the 1670s, was fitted by means of a slot that connected to a stud on the barrel.


Brass hilt
Straight blade for hacking and thrusting
Knuckle bow

▲ BRITISH BAKER RIFLE SWORD BAYONET

Date	c.1810
Origin	UK
Weight	907g (32oz)
Length	61cm (24in)

The Baker rifle was the first British army firearm to come with a sword bayonet (see pp.192–93). Regular army troops were equipped with a Baker and its sword bayonet during the Napoleonic Wars.

▼ VOLUNTEER INFANTRY SWORD BAYONET

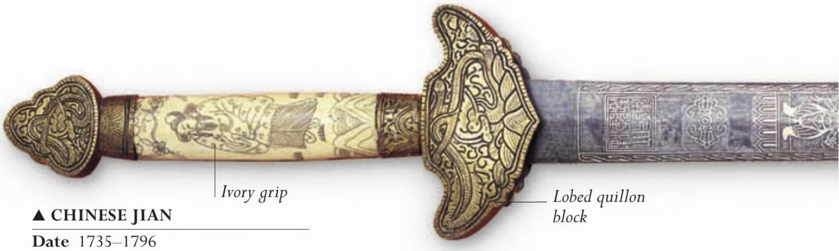
Date	1810
Origin	UK
Weight	500g (17½oz)
Length	77.5cm (30½in)

This sword bayonet, made by London gun-maker Staudenmayer, equipped volunteer infantrymen in the Napoleonic Wars. The bayonet used a knuckle grip to lock the rifle to the bayonet.

Straight steel blade

18TH-CENTURY SWORDS

Through the 1700s, the sword was becoming less important as an infantry weapon, although it was still valued by the heavy and light cavalry, and also often fulfilled a ceremonial role. In China, it accounted for two out of the four main weapons – the staff, the spear, the singled-edged *dao* sword, and the double-edged *jian* sword. Tibetans, too, had a tradition of sword manufacture, with designs that were similar to Chinese models. Swordsmiths of the Ottoman Empire, established by Turks who migrated from central Asia to Anatolia, favoured a curved blade derived from the Turko-Mongolian sabre of the 13th century.

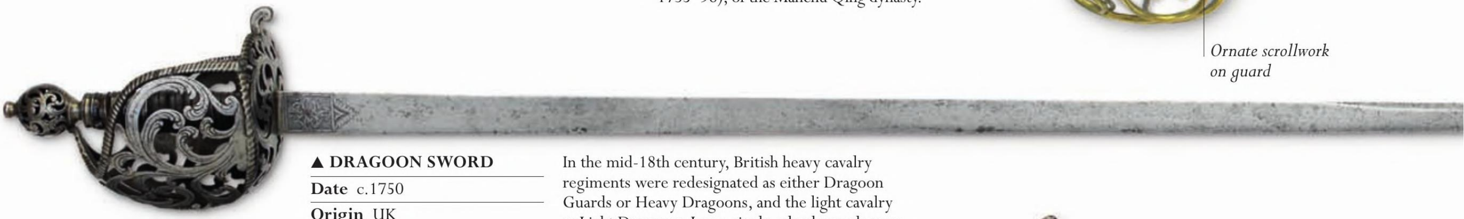

Ivory grip
Lobed quillon block

▲ CHINESE JIAN

Date	1735–1796
Origin	China
Weight	1.25kg (2¾lb)
Length	1.07m (3½ft)

Chinese swordsmen chose the straight, double-edged *jian* sword to show off their skills. This sword dates from the reign of Emperor Qianlong (ruled 1735–96), of the Manchu Qing dynasty.

Ornate scrollwork on guard

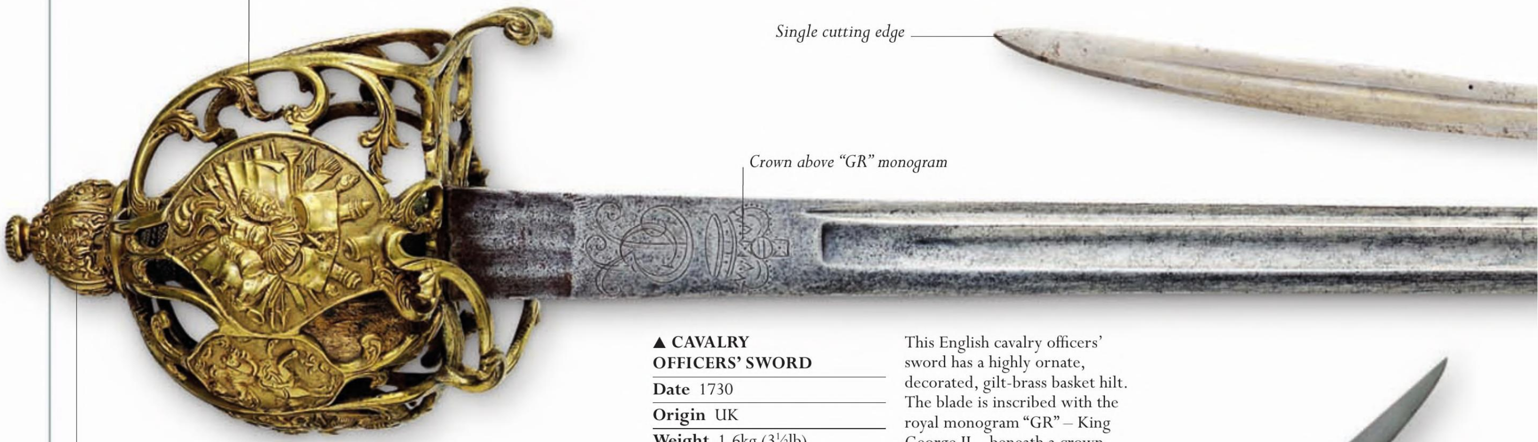


▲ DRAGOON SWORD

Date	c.1750
Origin	UK
Weight	1.15kg (2½lb)
Length	1.13m (3¾ft)

In the mid-18th century, British heavy cavalry regiments were redesignated as either Dragoon Guards or Heavy Dragoons, and the light cavalry as Light Dragoons. Long, single-edged swords were used by both divisions of heavy cavalry through the 18th century and into the Napoleonic era.

Basket hilt to protect knuckles


Single cutting edge
Gilt-brass basket hilt
Crown above "GR" monogram
Ornate pommel

▲ CAVALRY OFFICERS' SWORD

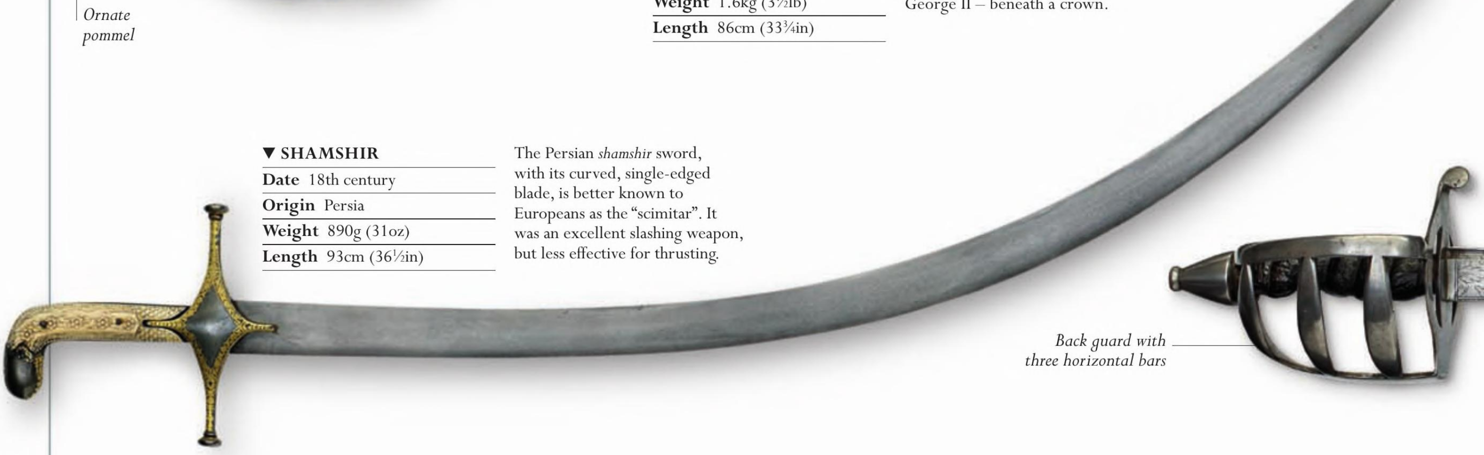
Date	1730
Origin	UK
Weight	1.6kg (3½lb)
Length	86cm (33¾in)

This English cavalry officers' sword has a highly ornate, decorated, gilt-brass basket hilt. The blade is inscribed with the royal monogram "GR" – King George II – beneath a crown.

▼ SHAMSHIR

Date	18th century
Origin	Persia
Weight	890g (31oz)
Length	93cm (36½in)

The Persian *shamshir* sword, with its curved, single-edged blade, is better known to Europeans as the "scimitar". It was an excellent slashing weapon, but less effective for thrusting.



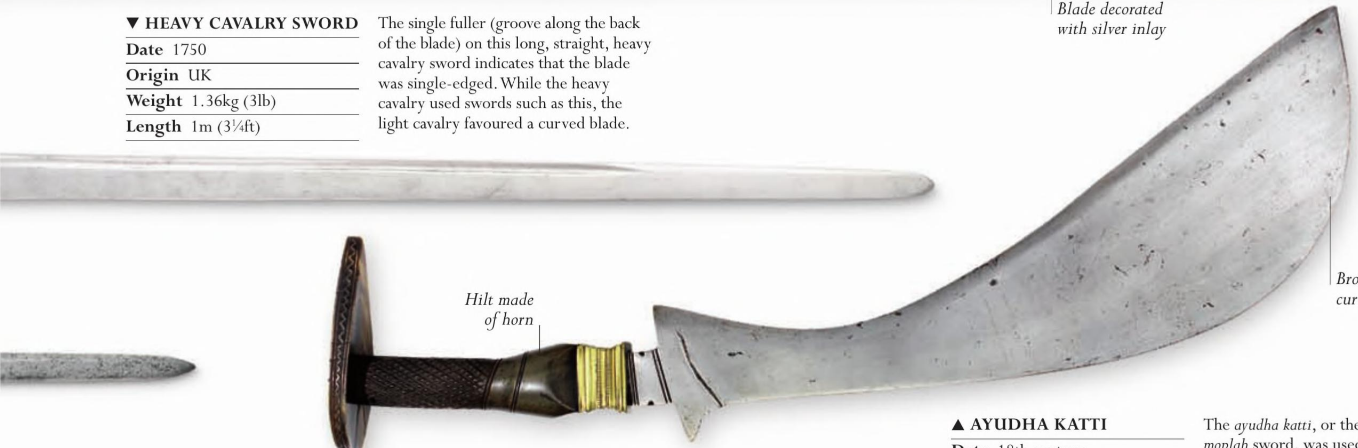
Back guard with three horizontal bars

Blade decorated with silver inlay

▼ HEAVY CAVALRY SWORD

Date	1750
Origin	UK
Weight	1.36kg (3lb)
Length	1m (3¼ft)

The single fuller (groove along the back of the blade) on this long, straight, heavy cavalry sword indicates that the blade was single-edged. While the heavy cavalry used swords such as this, the light cavalry favoured a curved blade.



Hilt made of horn

Broad, forward-curving blade

▲ AYUDHA KATTI

Date	18th century
Origin	India
Weight	1.15kg (2½lb)
Length	59.5cm (23½in)

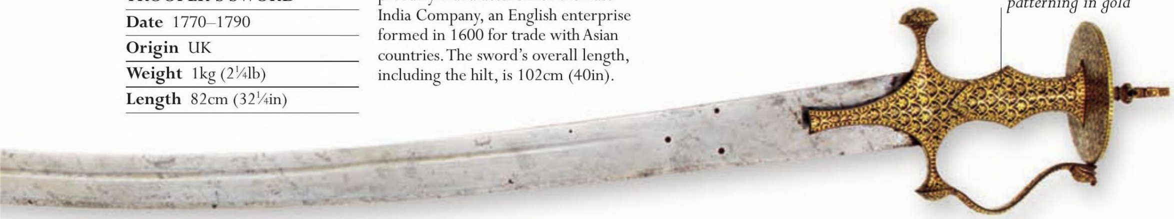
The *ayudha katti*, or the Indian *moplah* sword, was used by the Muslims in the Malabar Coast of southwestern India. It was developed from an implement used to cut through dense undergrowth.

Blade flattened towards tip

▲ CAVALRY TROOPER'S SWORD

Date	1770–1790
Origin	UK
Weight	1kg (2¼lb)
Length	82cm (32¼in)

This cavalry trooper's sword was probably manufactured for the East India Company, an English enterprise formed in 1600 for trade with Asian countries. The sword's overall length, including the hilt, is 102cm (40in).

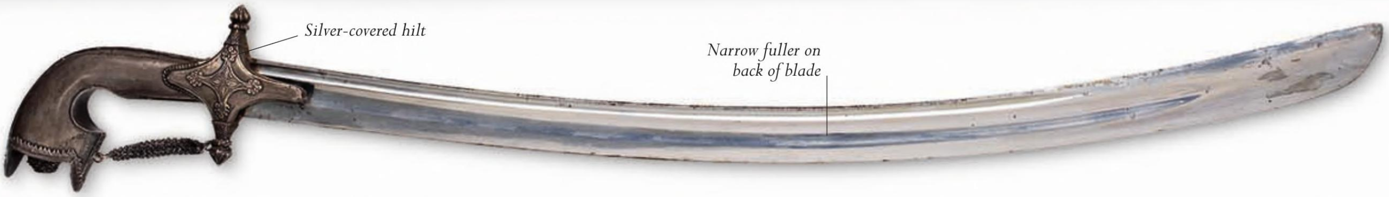


Leaf-frond patterning in gold

◀ NIZAMS' TALWAR

Date	18th century
Origin	India
Weight	1.1kg (2½lb)
Length	94.9cm (37¼in)

The blade inscription on this Indian *talwar*, or curved sword, suggests that it was made for the Nizams of Hyderabad, Muslim princes who ruled part of southern India from 1724.



Silver-covered hilt

Narrow fuller on back of blade

▲ NORTH AFRICAN SAIF

Date	Late 18th century
Origin	North Africa
Weight	700g (24¾oz)
Length	83.5cm (33in)

This *nimcha* or *saif* (Arabic words for sword) is of a type made in North Africa – a part of the Ottoman Empire from the 16th century – and in parts of Arabia associated with Yemen and the Hadramaut.

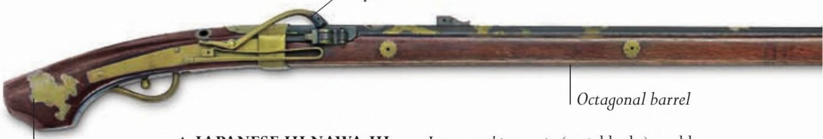
▼ HALF-BASKET CAVALRY SWORD

Date	c.1780
Origin	UK
Weight	1.1kg (2½lb)
Length	92cm (36¼in)

This half-basket cavalry sword is single-edged and marked "Gills Warranted": the manufacturer Gills of Birmingham was a major supplier of cavalry swords in the late 1700s.

18TH-CENTURY GUNS

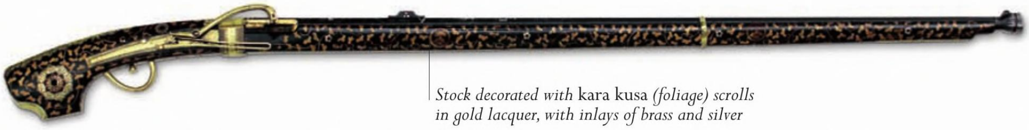
In 18th-century Europe, the flintlock musket was developed to a very high standard, one such example being the "Brown Bess" Land-Pattern musket – the weapon of choice for British infantry from 1722 to 1838. In Japan and India, however, the matchlock gun remained the dominant form of firearm. Japanese traders had come into contact with Portuguese matchlock guns in 1543, and within a few years their craftsmen had begun making weapons of this type. Because of Japan's subsequent isolationist policies, the matchlock remained the dominant gun design until well into the 1800s. Indian matchlocks were often superbly built and featured exquisite decorations using inlaid ivory, gold, silver, or bone.


Serpentine match holder
Octagonal barrel
Shishi *(guardian lion) made of inlaid brass*

▲ JAPANESE HI NAWA JU

Date	Early 18th century
Origin	Japan
Weight	4.14kg (9lb)
Barrel	1.03m (3½ft)
Calibre	13.3mm

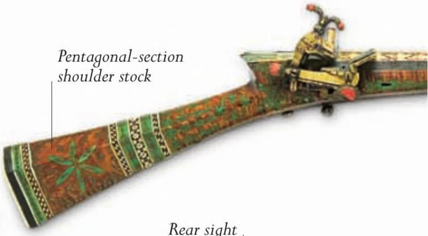
Japanese *hi nawa ju* (matchlocks) could fire three bullets a minute and pierce typical samurai armour at 50m (165ft). This matchlock was made by Kunitomo Tobei Shigeyasu of Omi, western Japan. The influence of the Sakai school is evident in its red-oak stock, although it has limited decoration.

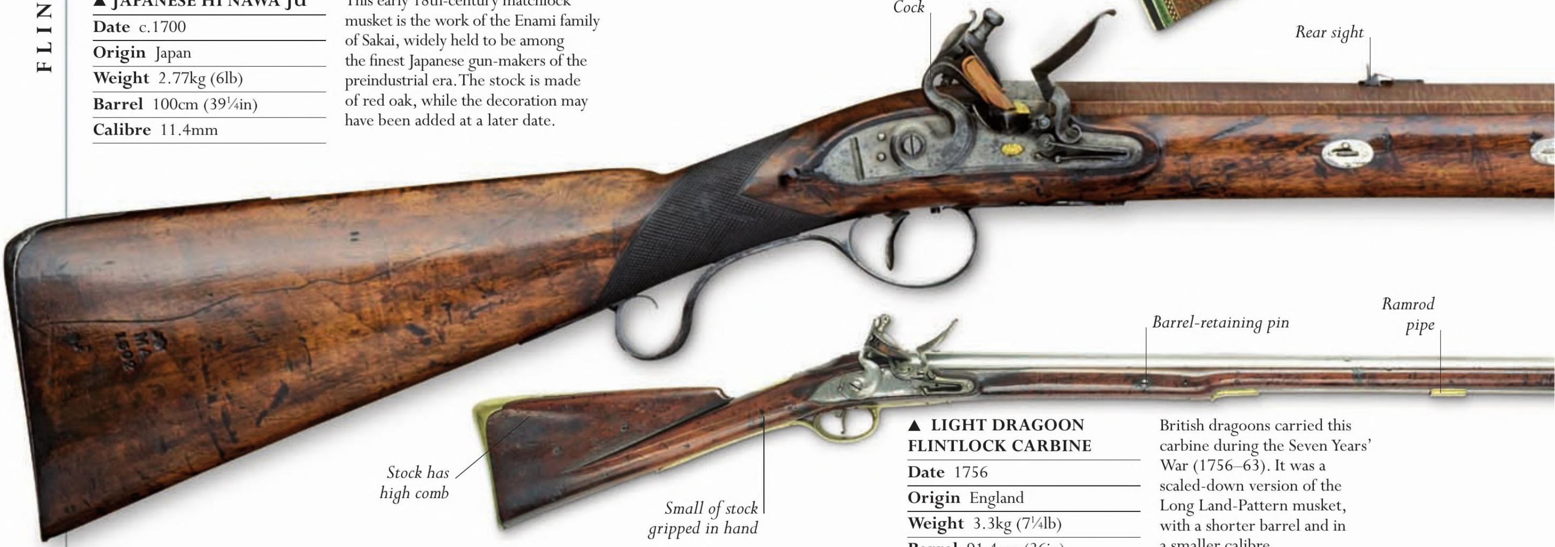

Stock decorated with kara kusa *(foliage) scrolls in gold lacquer, with inlays of brass and silver*

▲ JAPANESE HI NAWA JU

Date	c.1700
Origin	Japan
Weight	2.77kg (6lb)
Barrel	100cm (39¼in)
Calibre	11.4mm

This early 18th-century matchlock musket is the work of the Enami family of Sakai, widely held to be among the finest Japanese gun-makers of the preindustrial era. The stock is made of red oak, while the decoration may have been added at a later date.

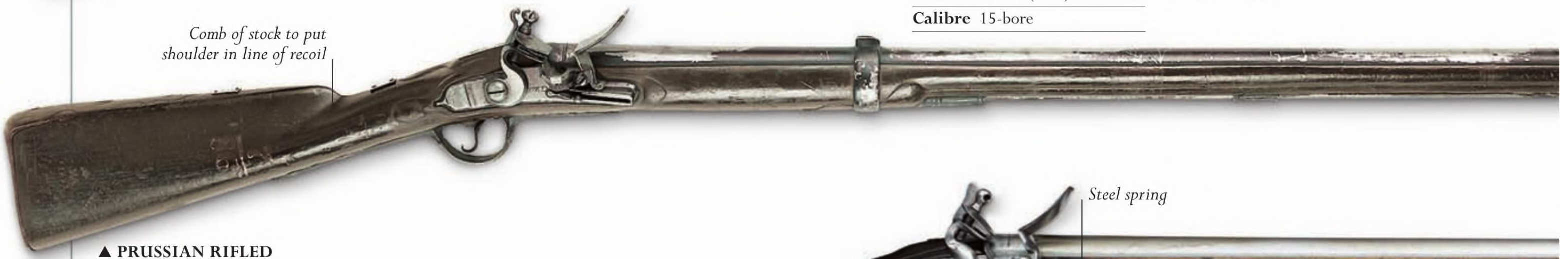

Pentagonal-section shoulder stock


Cock
Rear sight
Barrel-retaining pin
Ramrod pipe
Stock has high comb
Small of stock gripped in hand

▲ LIGHT DRAGOON FLINTLOCK CARBINE

Date	1756
Origin	England
Weight	3.3kg (7¼lb)
Barrel	91.4cm (36in)
Calibre	15-bore

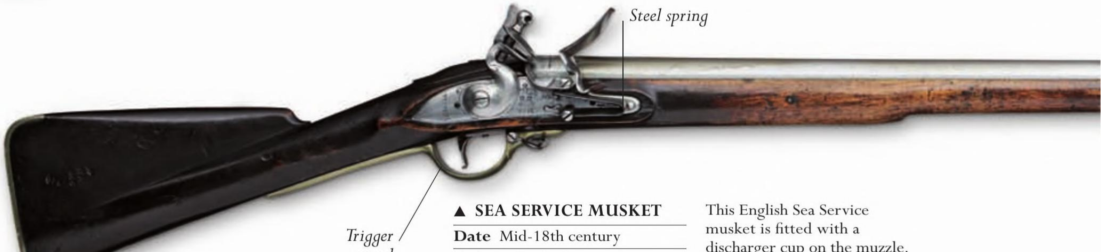
British dragoons carried this carbine during the Seven Years' War (1756–63). It was a scaled-down version of the Long Land-Pattern musket, with a shorter barrel and in a smaller calibre.


Comb of stock to put shoulder in line of recoil

▲ PRUSSIAN RIFLED FLINTLOCK CARBINE

Date	1722
Origin	Prussia
Weight	3.37kg (7½lb)
Barrel	94cm (37in)
Calibre	15-bore

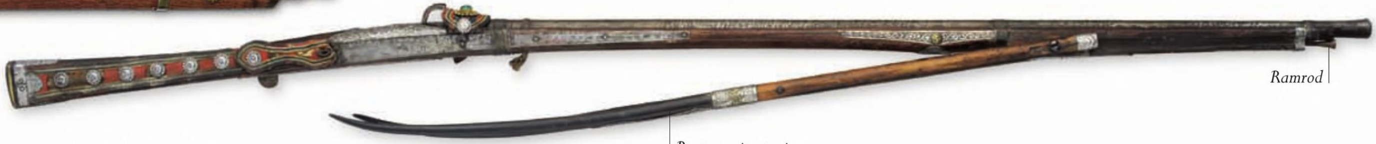
This carbine was manufactured until 1774 at the Prussian state arsenal at Potsdam (in modern-day Germany). The small of the stock is sized to fit in the hand, while the name of the armoury is stamped on the lock plate.


Steel spring
Trigger guard

▲ SEA SERVICE MUSKET

Date	Mid-18th century
Origin	England
Weight	4kg (8¾lb)
Barrel	94cm (37in)
Calibre	.75in

This English Sea Service musket is fitted with a discharger cup on the muzzle. The discharger fired cast-iron hand grenades, making this an ideal weapon for use prior to boarding.


Ramrod
Rest terminates in forked antelope horn

▲ TIBETAN MEDA

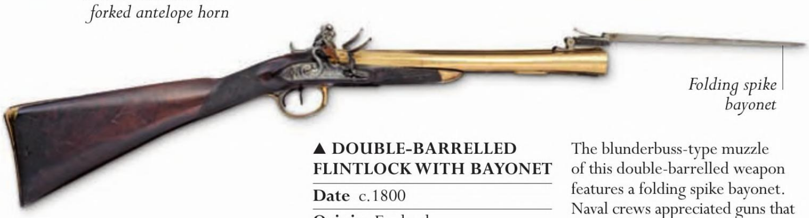
Date	c.1780
Origin	Tibet
Weight	4.15kg (9lb)
Barrel	1.11m (3¾ft)
Calibre	17mm

Tibet was largely isolated from the rest of the world but carried out trade with India and China. This *meda* (matchlock) shows Chinese influence in form and decoration. Attached to the fore stock is an unusual rest, while the ramrod is a modern replacement.

▲ TURKISH SNAPHAUNCE

Date	Late 18th century
Origin	Turkey
Weight	2.69kg (6lb)
Barrel	72.4cm (28½in)

The smoothbore Turkish *tüfek*, or musket, combines a pentagonal-section butt with an octagonal barrel. Its lock is a snaphaunce, a predecessor of the flintlock, which had become obsolete in northern Europe by the early 1600s.


Folding spike bayonet

▲ DOUBLE-BARRELLED FLINTLOCK WITH BAYONET

Date	c.1800
Origin	England

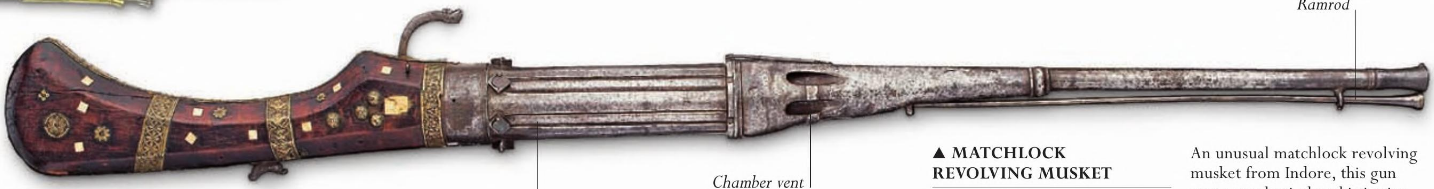
The blunderbuss-type muzzle of this double-barrelled weapon features a folding spike bayonet. Naval crews appreciated guns that combined short-range firepower with a stabbing weapon.

Grooved barrel
Ramrod

▲ ENGLISH FLINTLOCK RIFLE

Date	1791
Origin	England
Weight	3.5kg (7¾lb)
Barrel	81cm (32in)
Calibre	.680in

Innovative London gunsmith Henry Nock made several volley guns for the Royal Navy and numbered Ezekiel Baker among his apprentices. Nock designed this flintlock weapon – possibly an officer's private purchase – with nine-groove rifling.

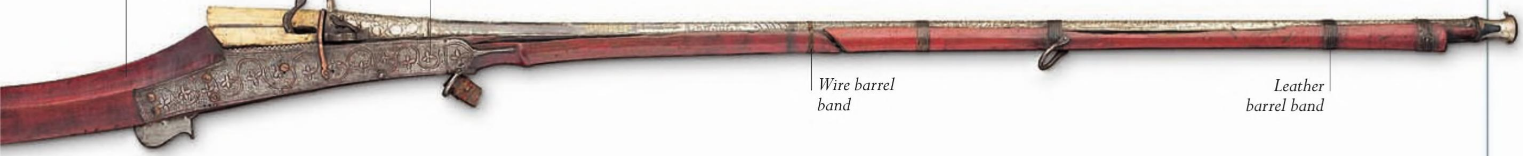

Ramrod
Chamber vent
Revolving cylinder with six chambers

▲ MATCHLOCK REVOLVING MUSKET

Date	c.1800
Origin	India
Weight	5.9kg (13lb)
Barrel	62cm (24½in)
Calibre	.6in

An unusual matchlock revolving musket from Indore, this gun uses a mechanical sophistication sometimes seen in European flintlocks – the use of a revolving cylinder to create a multi-shot weapon. The cylinder is indexed manually.

Discharger cup
Sling swivel


Pentagonal-section butt
Decorated iron lock plate
Wire barrel band
Leather barrel band

▼ INDORE TORADAR

Date	c.1800
Origin	India
Weight	3.4kg (7½lb)
Barrel	1.12m (3¾ft)
Calibre	.55in

This simple matchlock from Indore, central India, has a pronounced recurve. Four leather thongs serve as barrel bands, although the one closest to the breech is made of wire.

FLINTLOCK MUSKETS AND BAYONETS

THE BATTLE OF FONTENOY

The European wars of the mid-18th century were contested with a mixture of formality and savagery. The battle at Fontenoy is a classic example of an era dominated by the musket-volleys of disciplined infantry, manoeuvring with parade-ground precision in spite of heavy casualties.

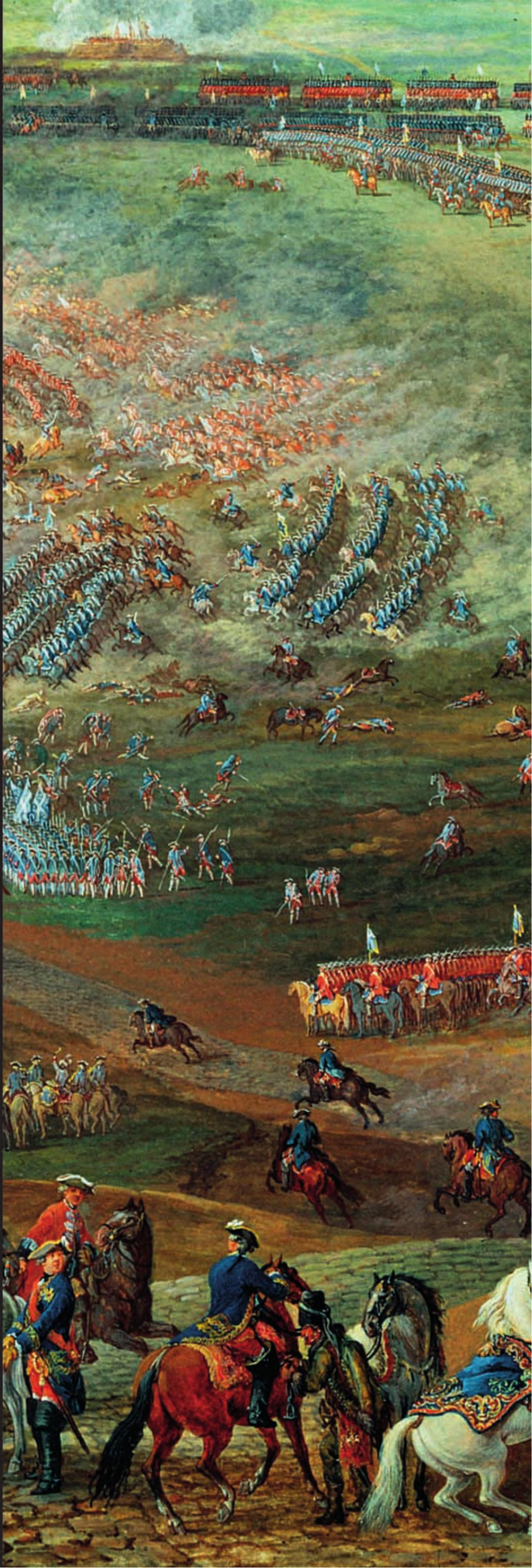
In 1745, during the War of the Austrian Succession, a French army, commanded by Maurice de Saxe, was campaigning in Flanders. Its opponent, the Pragmatic Army, consisted of Dutch, British, Austrian, and Hanoverian forces under the command of the Duke of Cumberland, son of King George II. Saxe seized the strategic initiative by laying siege to the fortress town of Tournai. The Pragmatic Army had to aid the town, thus allowing Saxe to meet them on a ground of his choosing. He took up a defensive position along a ridge in front of Tournai, anchored by the River Scheldt on his right flank and woods on his left. He fortified two villages, Antoing and Fontenoy, and had five redoubts – earthwork strongpoints – constructed in front of the line. The Pragmatic Army approached Fontenoy on 9 May after an exhausting march. Without having fully appreciated the strength of Saxe's position, the Allied commanders decided to attack on 11 May.

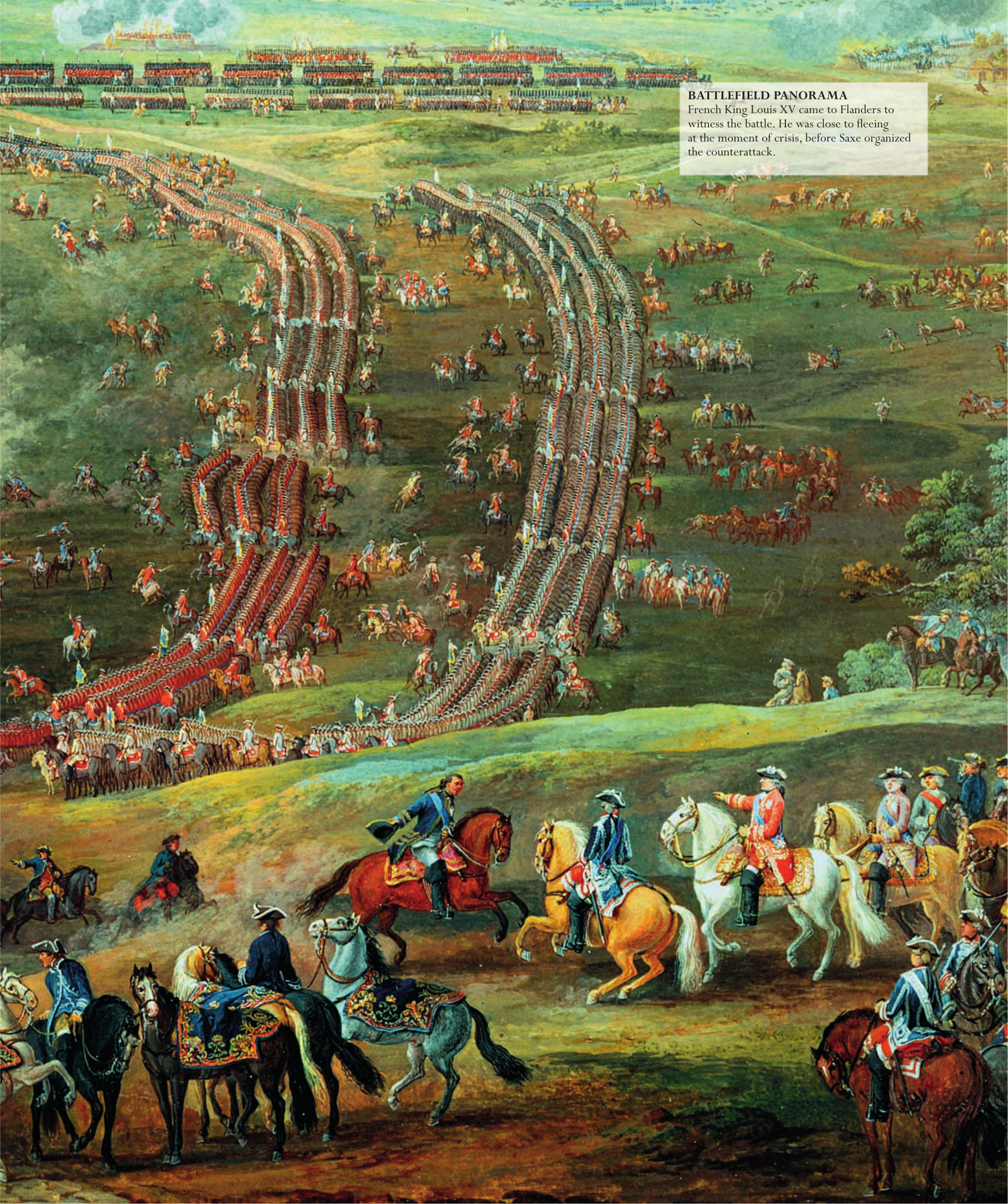
HOLDING THE FIELD

The rival armies were each around 50,000 strong. Aristocratic officers led bodies of mostly professional soldiers, the infantry armed with flintlock musket and bayonet. The French had over 100 cannon, probably more than their opponents, and were also superior in cavalry. The ragmatic Army deployed with the Dutch and Austrians on its left, the Hanoverians and British on the right. The attack began badly. After an ineffectual preliminary bombardment by heavy cannon, frontal infantry assaults against the French right crumbled in the face of withering firepower. On the French left, the Redoubt of Eu remained intact because the British officer ordered to take it refused to move, apparently unnerved by French skirmishers in the nearby woods.

With the attack having failed to his left and right, Cumberland decided to advance. Urged on, the British infantry marched smartly up the hill between Fontenoy and the intact redoubt. Cannonballs fired from the flanking strongpoints carved gaps in the British ranks, but, undeterred, they progressed to the top of the ridge, bringing them face to face with the opposing infantry. According to the French writer Voltaire, the commanders of the British and French guards each politely called on the other to fire first. There was an end to civilities once the point-blank exchange began, for soldiers fell in heaps, hundreds cut down by a single volley. The British pushed their field guns forward to batter the French with grapeshot, at which point the French line collapsed.

Saxe mustered reserves of infantry and cavalry to launch desperate counterattacks. Having advanced deep into the French position, the British faced assaults from the flanks as well as the front. The Irish Brigade, the "Wild Geese", fighting as mercenaries in the French army, delivered an especially destructive charge. Forced to give way, the British infantry managed an orderly retreat, screened by their cavalry. The French held the field and claimed the victory. The day's fighting had cost some 5,000 lives, with more than twice that number wounded, and many of them maimed for life.

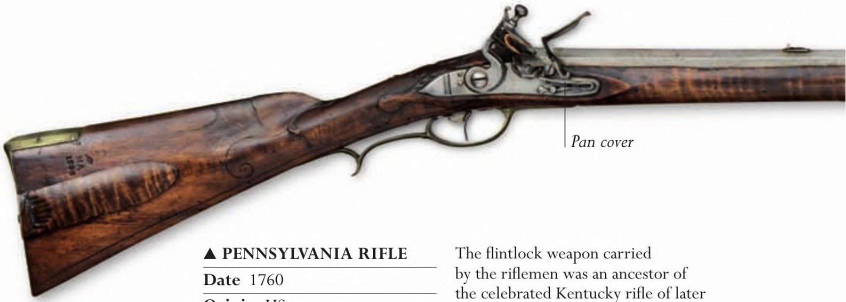




BATTLEFIELD PANORAMA
French King Louis XV came to Flanders to witness the battle. He was close to fleeing at the moment of crisis, before Saxe organized the counterattack.

RIFLEMEN OF THE AMERICAN REVOLUTION

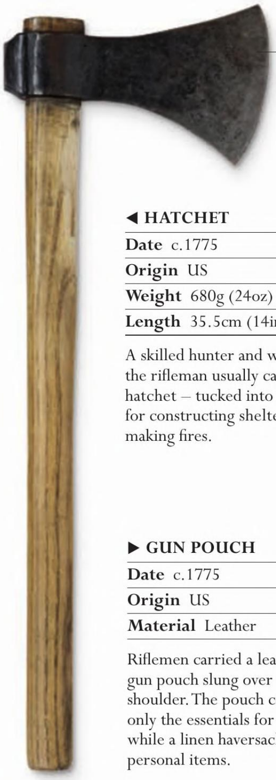
At the start of the American Revolutionary War in 1775, skilled riflemen were among the first companies of soldiers raised by the rebellious North American colonies to fight the British Army and its Loyalist supporters. These riflemen had their origins in the American frontier world of hunters and farmers, and relied on their skill with a long-barrelled rifle to carve out a life in the wild. Some riflemen were incorporated into units of General George Washington's army, but others retained their independent spirit along with their own equipment and clothing. They proved themselves effective snipers and skirmishers.



▲ PENNSYLVANIA RIFLE

Date	1760
Origin	US
Weight	3.8kg (8¼lb)
Barrel	1.14m (3¾ft)
Calibre	.45

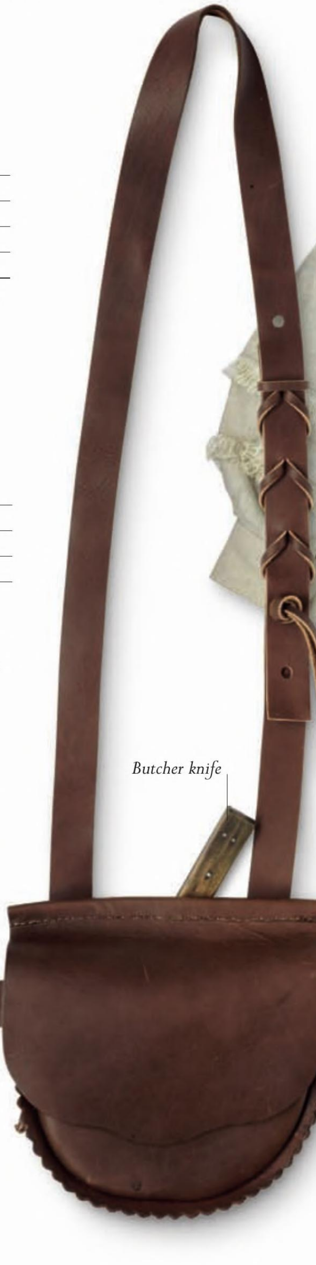
The flintlock weapon carried by the riflemen was an ancestor of the celebrated Kentucky rifle of later American frontiersmen. In well-trained hands, it had an accuracy of up to 365m (1,200ft). The long, rifled barrel made it far more accurate than the muskets used by European armies.



◀ HATCHET

Date	c.1775
Origin	US
Weight	680g (24oz)
Length	35.5cm (14in)

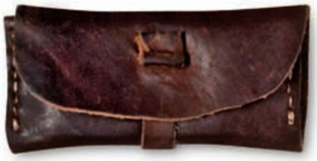
A skilled hunter and woodsman, the rifleman usually carried a hatchet – tucked into his belt – for constructing shelters and making fires.



▶ GUN POUCH

Date	c.1775
Origin	US
Material	Leather

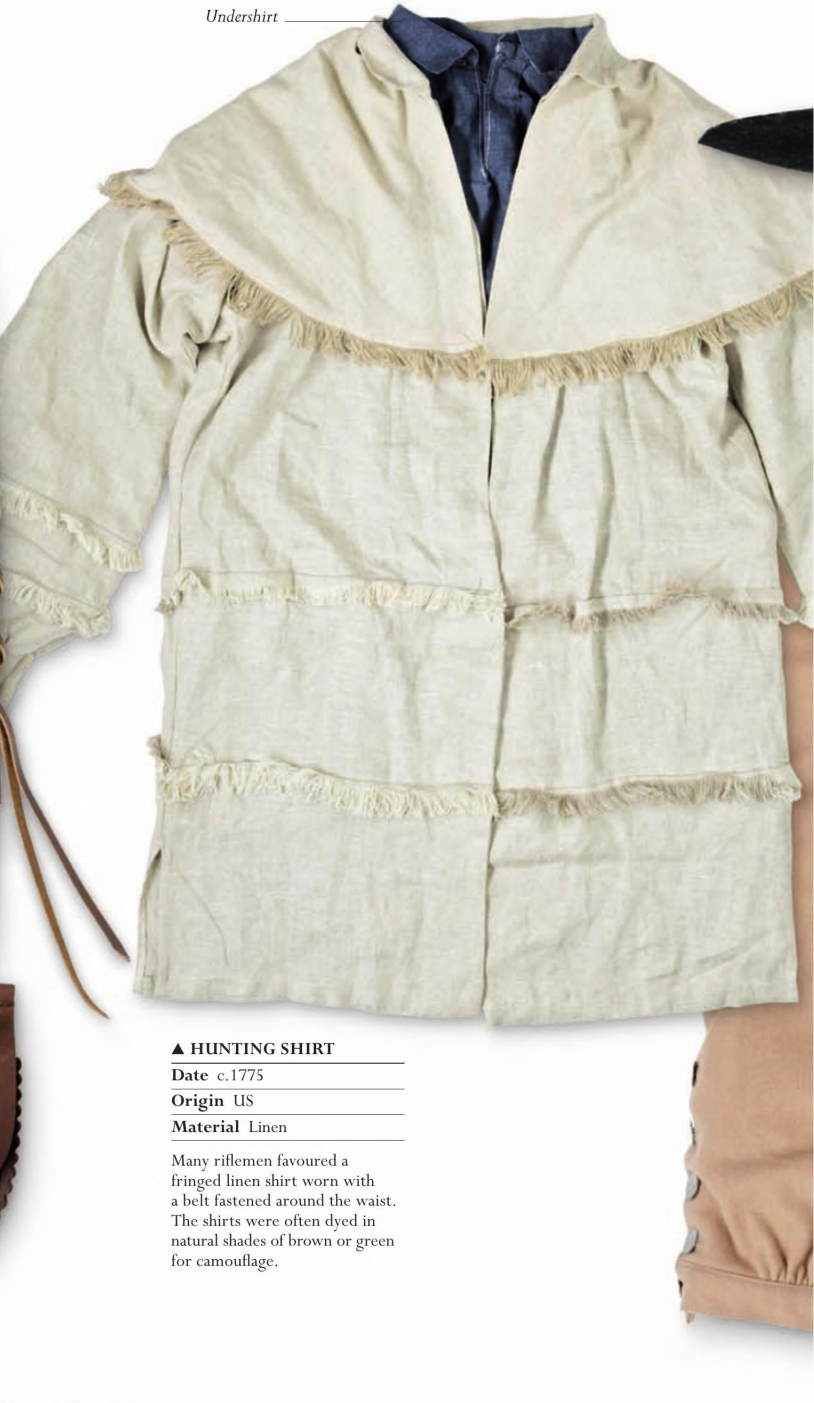
Riflemen carried a leather gun pouch slung over the shoulder. The pouch contained only the essentials for their rifle, while a linen haversack held personal items.



▲ FLINT POUCH

Date	c.1775
Origin	US
Material	Leather

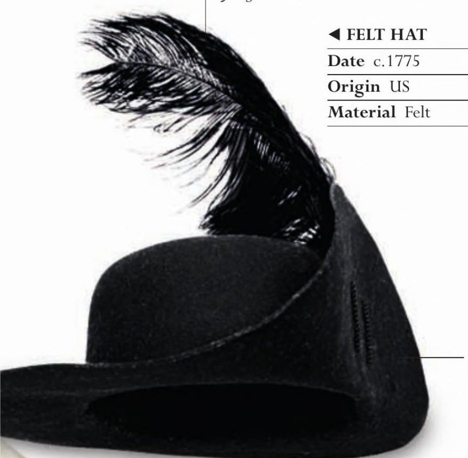
Using tow (hemp or flax fibres) to catch sparks struck from his flint and steel, a rifleman could light a fire. He often also carried a pouch of dry kindling.



▲ HUNTING SHIRT

Date	c.1775
Origin	US
Material	Linen

Many riflemen favoured a fringed linen shirt worn with a belt fastened around the waist. The shirts were often dyed in natural shades of brown or green for camouflage.



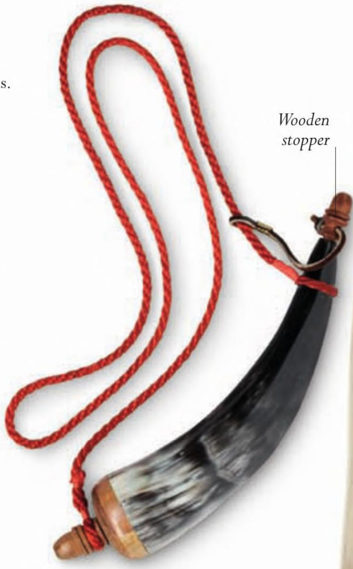
◀ FELT HAT

Date c.1775

Origin US

Material Felt

The flamboyant headgear of the riflemen reflected their prewar life spent in tracking and hunting animals. Many riflemen decorated their hats with animal tails instead of feathers.



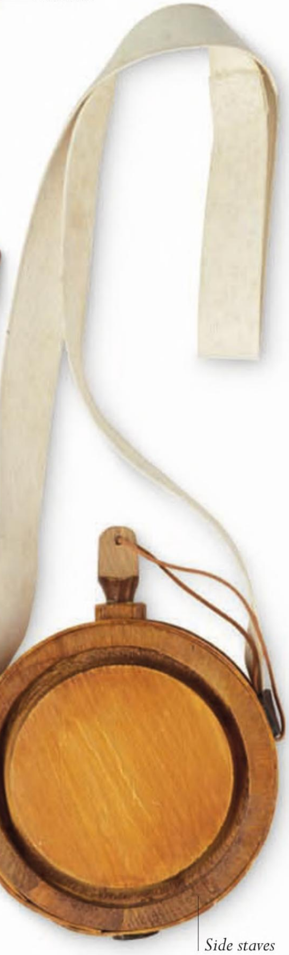
▶ POWDER HORN

Date c.1775

Origin US

Material Horn

Riflemen carried their gunpowder in a horn. They measured out the main charge, which was poured down the muzzle, as well as the primer, which was tipped into the pan.



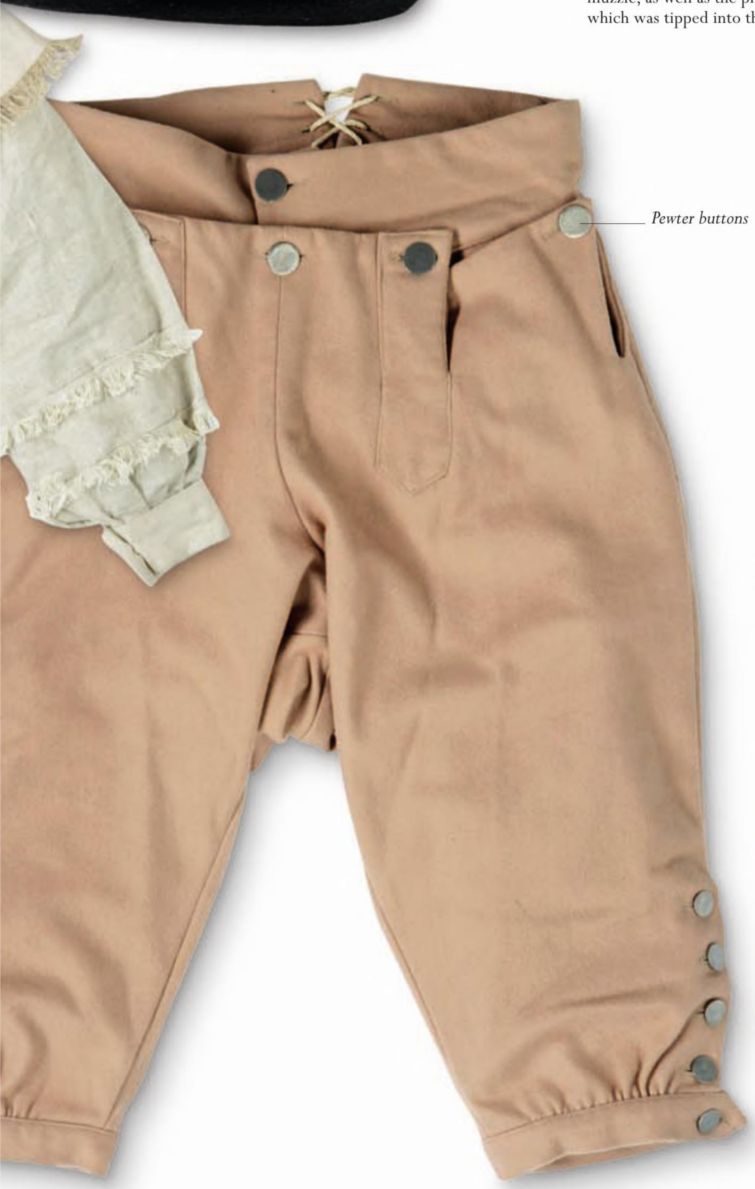
▶ CANTEEN

Date c.1775

Origin US

Material Wood

A rifleman's wooden canteen was constructed like a barrel with side staves. It had to be refilled whenever possible or the wood would shrink, resulting in leakage.



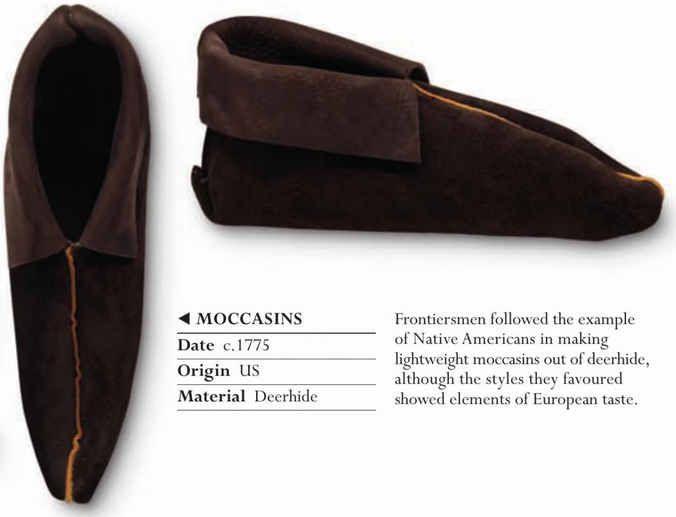
◀ BREECHES

Date c.1775

Origin US

Material Wool

Riflemen wore woollen breeches with leggings made of hide or a simple blanket material. They were fastened with pewter buttons at the waist, pockets, front flap, and knee.



◀ MOCCASINS

Date c.1775

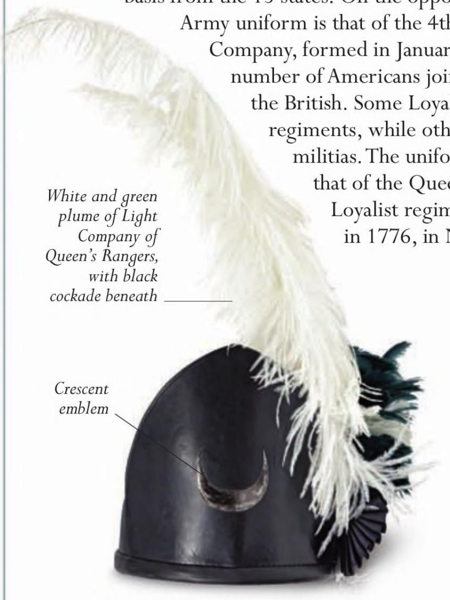
Origin US

Material Deerhide

Frontiersmen followed the example of Native Americans in making lightweight moccasins out of deerhide, although the styles they favoured showed elements of European taste.

WEAPONS, UNIFORMS, AND KIT OF THE AMERICAN REVOLUTION

At the Continental Congress, in June 1775, the 13 American colonies in revolt against British rule decided to form an army under the command of General George Washington. Initially made up of New England militiamen and rifleman volunteers, this Continental Army was later recruited on a quota basis from the 13 states. On the opposite page, the Continental Army uniform is that of the 4th Maryland Independent Company, formed in January 1776. A significant number of Americans joined up to fight alongside the British. Some Loyalists formed British regiments, while others fought in irregular militias. The uniform shown here is that of the Queen's Rangers, a Loyalist regiment established in 1776, in New York.


White and green plume of Light Company of Queen's Rangers, with black cockade beneath
Crescent emblem

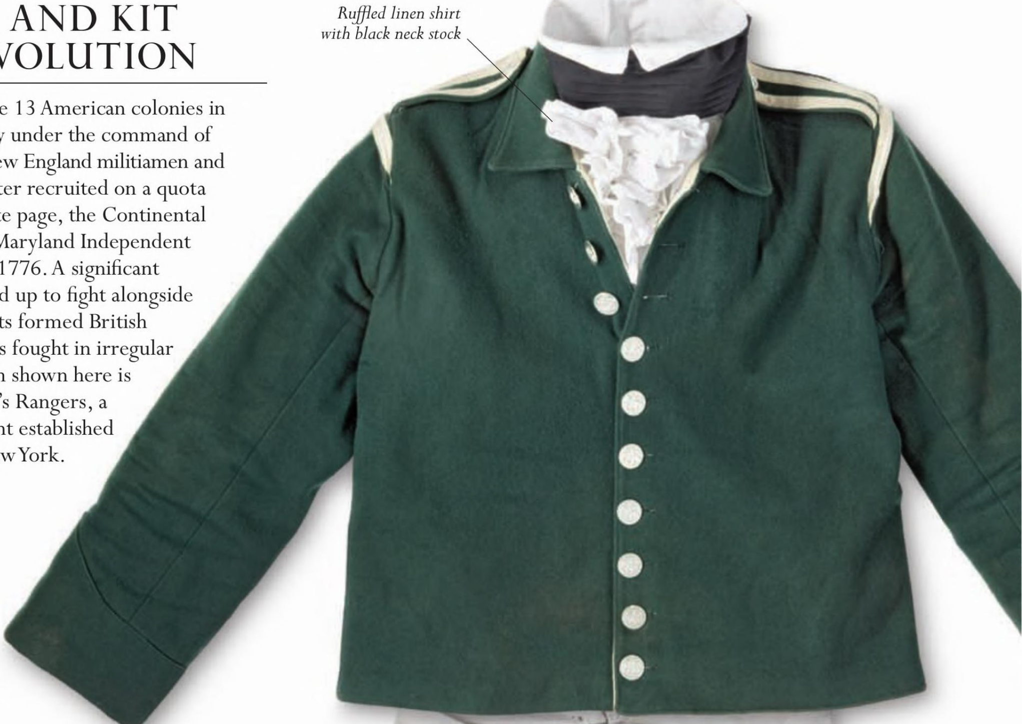
▲ QUEEN'S RANGERS PLUMED CAP

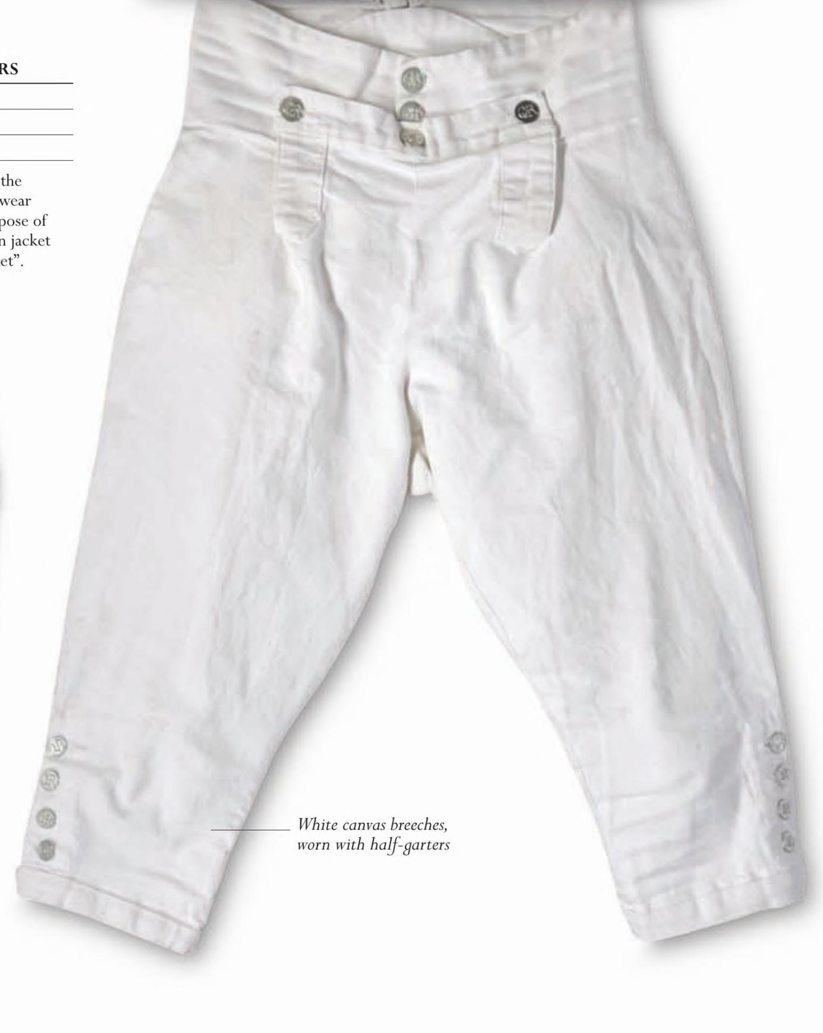
Date 1776

Origin US

Material Leather, feather

The Queen's Rangers were named in honour of George III's wife, Queen Caroline. Their leather cap bore the black cockade of the royal house of Hanover.


Ruffled linen shirt with black neck stock


White canvas breeches, worn with half-garters

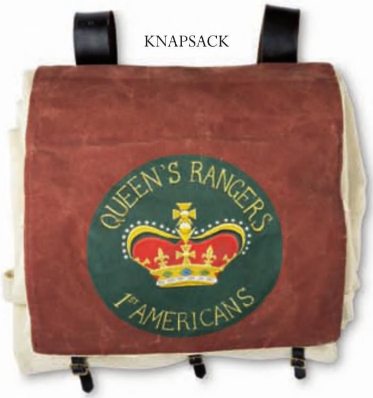
▶ QUEEN'S RANGERS JACKET AND TROUSERS

Date 1776

Origin US

Material Linen, canvas

This Loyalist regiment was the first in the British Army to wear green uniforms for the purpose of camouflage. The short green jacket was known as a "round jacket".


KNAPSACK
QUEEN'S RANGERS
1st AMERICANS

CARTRIDGE BOX

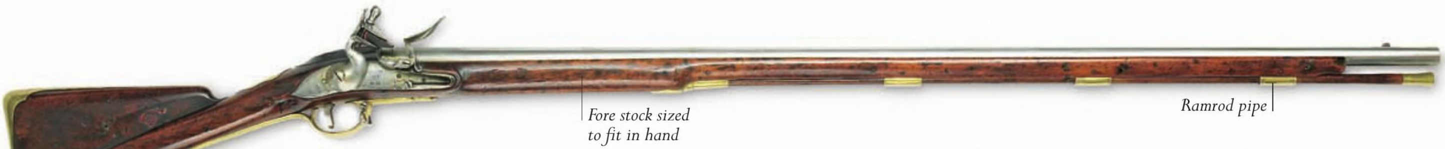
▲ QUEEN'S RANGERS KNAPSACK AND CARTRIDGE BOX

Date 1776

Origin US

Material Canvas, leather

Both the knapsack and the cartridge box bear an image of George III's crown. The brass badge on the cartridge box has the initials GR (*George Rex*).


Fore stock sized to fit in hand
Ramrod pipe

▲ LONG LAND-PATTERN FLINTLOCK MUSKET

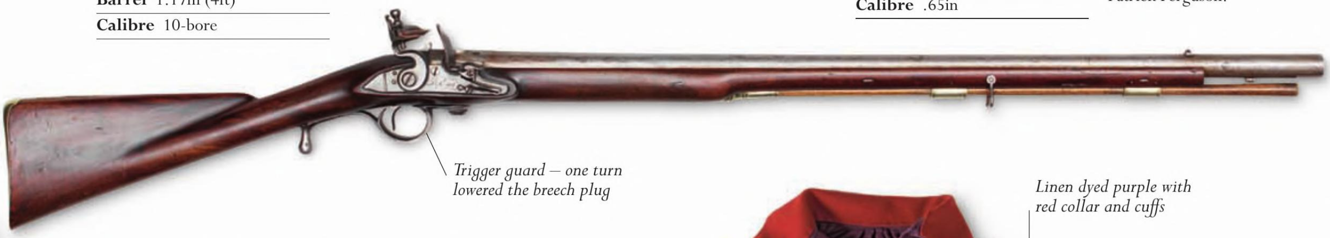
Date	1742
Origin	England
Weight	4.7kg (10¼lb)
Barrel	1.17m (4ft)
Calibre	10-bore

Most British infantrymen in the American War used the "Brown Bess" Land-Pattern musket. This long version of the gun was first issued in 1722, while shorter versions followed in 1768 and 1797.

▼ FERGUSON RIFLE

Date	1776
Origin	England
Weight	3.5kg (7½lb)
Length	1.21–1.52m (4–5ft)
Calibre	.65in

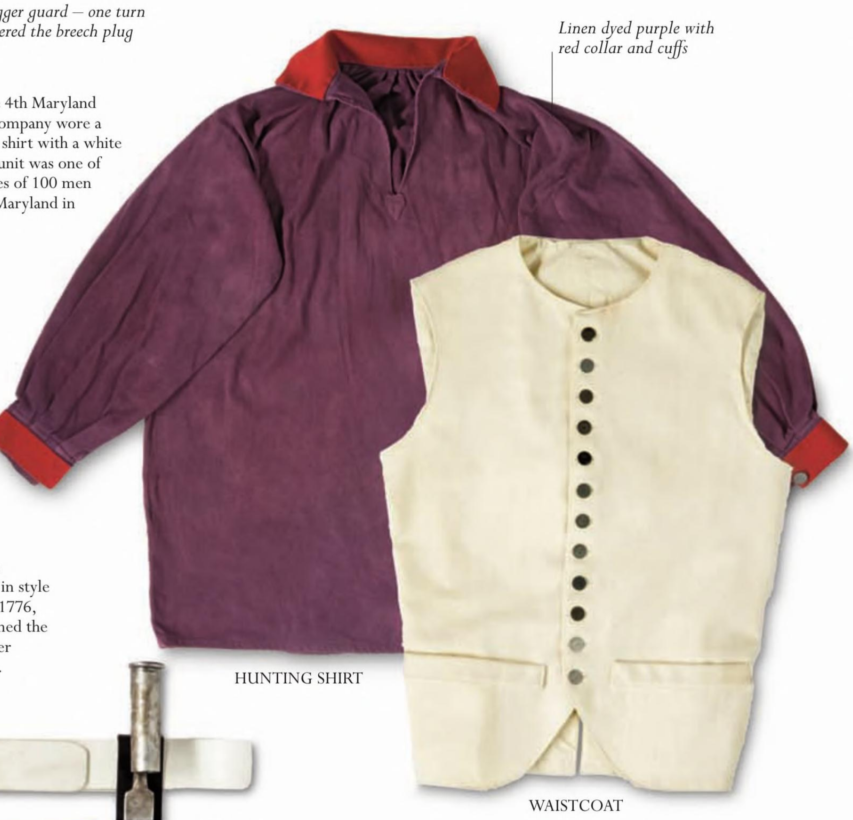
The breech-loading Ferguson rifle was used in limited numbers on the British side in the American Revolutionary War. It was designed by a Scottish army officer, Major Patrick Ferguson.

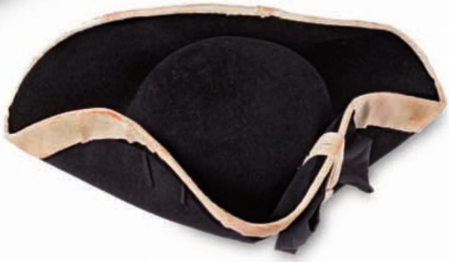

Trigger guard – one turn lowered the breech plug

▶ MARYLAND INDEPENDENT COMPANY SHIRT AND WAISTCOAT

Date	1776
Origin	US
Material	Linen

The men of the 4th Maryland Independent Company wore a purple hunting shirt with a white waistcoat. The unit was one of seven companies of 100 men authorized by Maryland in January 1776.


Linen dyed purple with red collar and cuffs
HUNTING SHIRT
WAISTCOAT



▲ MARYLAND INDEPENDENT COMPANY TRICORNE HAT

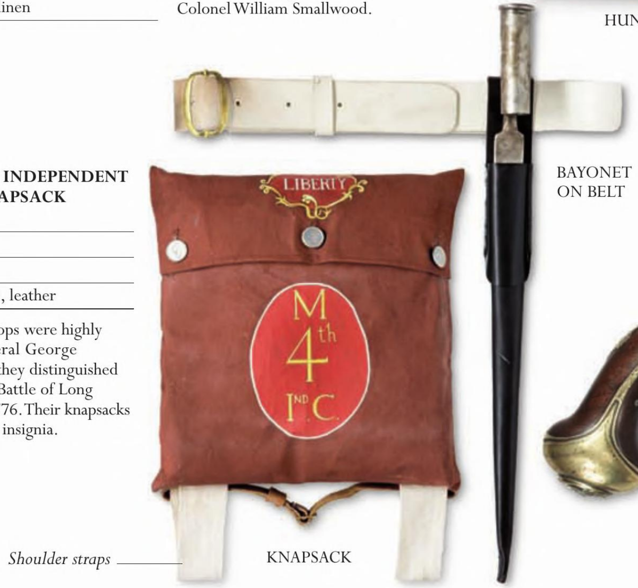
Date	1776
Origin	US
Material	Wool, linen

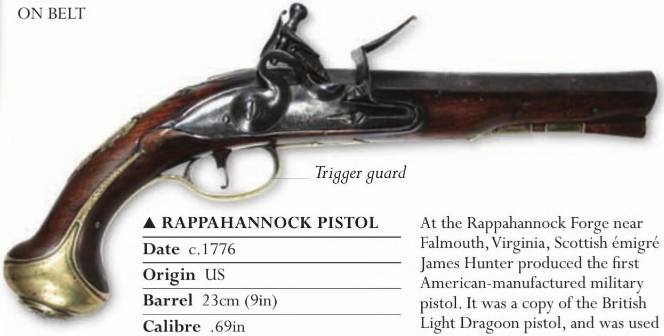
The soldiers wore a tricorne (three-cornered) hat similar in style to British regulars. By spring 1776, nine companies together formed the 1st Maryland Regiment under Colonel William Smallwood.

▶ MARYLAND INDEPENDENT COMPANY KNAPSACK AND BELT

Date	1776
Origin	US
Material	Canvas, leather

The Maryland troops were highly regarded by General George Washington after they distinguished themselves at the Battle of Long Island in August 1776. Their knapsacks bore the company insignia.


BAYONET ON BELT
LIBERTY
M
4th
IND C.
Shoulder straps
KNAPSACK


Trigger guard

▲ RAPPAHANNOCK PISTOL

Date	c.1776
Origin	US
Barrel	23cm (9in)
Calibre	.69in

At the Rappahannock Forge near Falmouth, Virginia, Scottish émigré James Hunter produced the first American-manufactured military pistol. It was a copy of the British Light Dragoon pistol, and was used by the Light Dragoons in the Continental Army.

KEY DEVELOPMENT

THE DEVELOPMENT OF SIEGE WARFARE

By the late 17th century, the construction of fortifications and the conduct of sieges in Europe had become elaborate and formalized, and were the subject of learned treatises by renowned engineers, as well as the focus of military campaigns.

The introduction of cannon into European siege warfare from the 15th century triggered the rapid evolution in defensive fortifications. The challenge was to make a fortress that was less vulnerable to cannon fire than the old stone castles, while being capable of using cannon as a defensive armament. In place of high castle walls, military engineers developed a squat structure known as a "star fort" (see p.117). This was a polygonal fortification, half buried behind a deep, wide ditch, with bastions protruding at each angle. The bastions were wedge-shaped artillery platforms that provided an all-round field of fire, so that soldiers assaulting the walls, or another bastion, would come under fire from the flank or rear. A slope, or "glacis", of earth in front of the ditch further protected the walls against cannon shot. This basic model was soon developed further, with outworks – fortifications built outside the fortress to delay or prevent besieging forces advancing their guns and soldiers to the main walls.

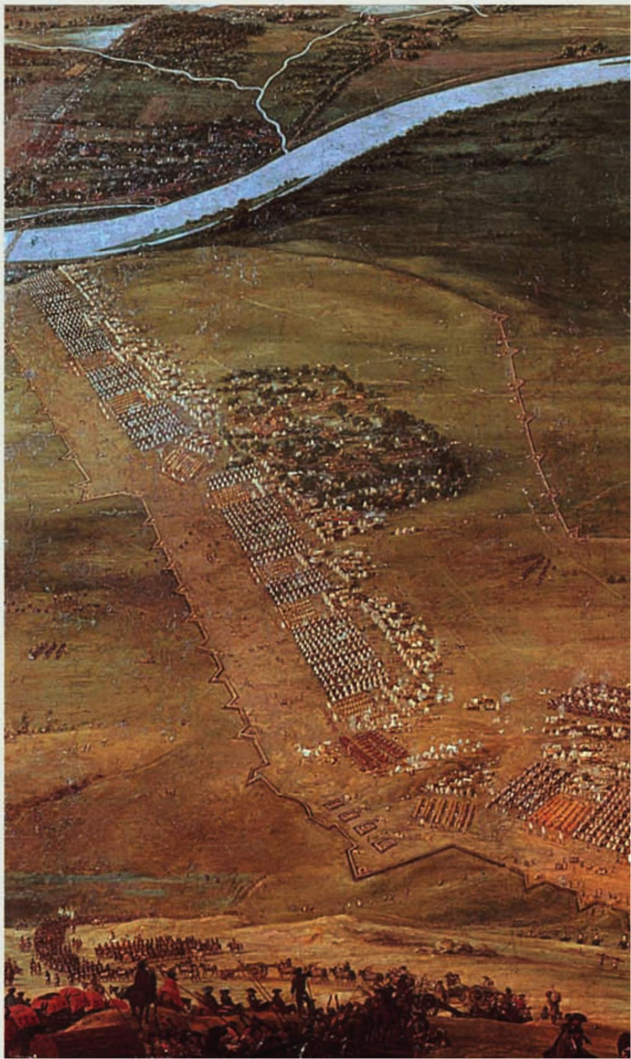
NEW STRUCTURES

During the 17th century, the complexity of major fortifications left the simple "star fort" model behind. Triangular fortifications, or outworks, called "ravelins" (or "demi-lunes") thrust forward between angle bastions. Vulnerable points were defended by "hornworks" – defensive structures comprising two bastions joined by a short wall. Citadels were built as back-up forts within fortress towns, where garrisons could continue resistance after the town had fallen. These complex fortifications were expensive to build and man. Many fortifications were built by the Dutch Republic, which was threatened first by Spain in the Eighty Years' War (1568–1648) and then France in the wars of Louis XIV (reigned 1643–1715). Louis XIV, meanwhile, authorized his chief engineer, the Marquis de Vauban, to build a string of fortresses along the frontiers of France.

By the time of Louis XIV's reign, sieges were the focal points of conflicts. In the Nine Years' War (1688–97), pitting France against a Grand Alliance that included the Dutch, there were 21 major sieges. Field battles resulted chiefly from efforts to relieve ongoing sieges.

WEAPONS OF WAR

Special weaponry evolved for siege warfare, including mortars that launched explosive shells over walls or into siege trenches, and grenades, which were hurled by a new type of elite soldier, the grenadier. Engineers, such as Vauban and his Dutch counterpart, Menno van Coehoorn, formalized and set out the conduct of sieges in treatises. Despite this formality, the siege tactics

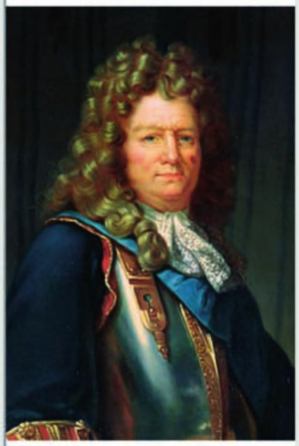


KEY **FIGURE**

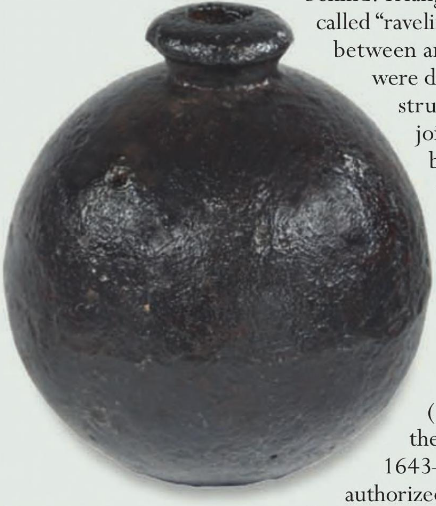
MARQUIS DE VAUBAN

1633–1707

France's greatest military engineer, Vauban, directed his first siege in 1657, aged 24. Having won the confidence of King Louis XIV, he oversaw the construction of 37 French fortresses and improved more than 300. But he was, above all, valued for his innovative and aggressive conduct of sieges, employing the system of saps and parallels.



▲ After directing 48 sieges during the course of his career, Vauban retired in 1703 with the rank of marshal.

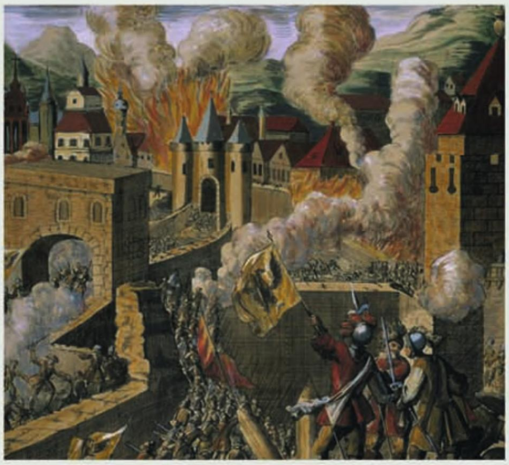


▲ MORTAR SHELL
Mortars fired explosive shells consisting of a spherical iron casing packed with gunpowder and ignited by a burning fuse. They saw much use during sieges.

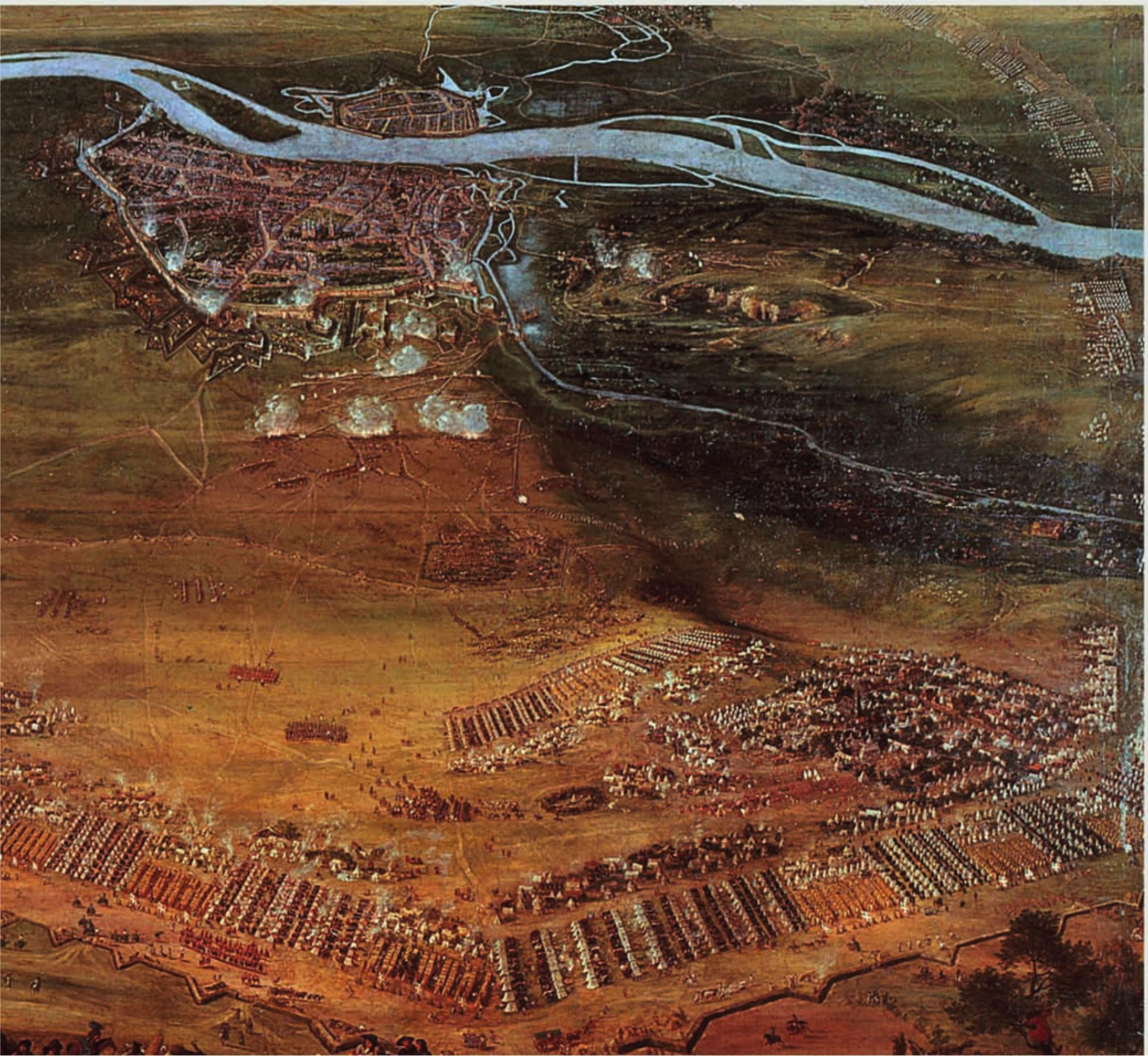
of Louis XIV's wars were aggressive and designed to produce a rapid result. These tactics involved digging trenches towards enemy fortifications in a zig-zag, so that fire could not rake the trench from end to end. At intervals, engineers dug transverse "parallels", lines to which the siege cannon then advanced. Under Vauban's system, the third parallel was the last. From there, soldiers might emerge from their trenches, with grenadiers at the fore, to mount an assault on the "covered way" – the defensive position held by the enemy infantry, on the outer edge of the fortress's ditch. Once this position was taken, siege cannon could advance close to the walls, and the defenders would be expected to surrender – a gesture rewarded by honourable treatment. Of course, actual sieges only approximated this pattern: for example, tunnelling sappers might blow up walls using mines, or moats might be drained or crossed by soldiers on rafts.

Ironically, despite the money lavished upon them, by the 18th century fortifications rarely resisted a siege for long. The golden age of siege warfare and fortifications was over by 1720.

> "The **more powder we burn,** the **less blood we lose**"
>
> **ATTRIBUTED TO MARQUIS DE VAUBAN**, AT THE SIEGE OF CHARLEROI, 1693



◂ THE SACK OF MAGDEBURG
If defenders refused to surrender, they faced massacre when fortifications were taken by assault. At Magdeburg, in 1631, over 20,000 people were killed when the city fell after a six-month siege.



◂ THE SIEGE OF MAASTRICHT
In June 1673, French King Louis XIV, invading the Netherlands, besieged the fortress city of Maastricht with an army of 45,000 men. Vauban directed the siege, overcoming the defences within the month.

KEY **EVENTS**

1650–1700

- **1667** The French army details specific soldiers to specialize in throwing grenades – the first instance of grenadiers.
- **1674** Dutch military engineer Menno van Coehoorn introduces a man-portable mortar gun for use in sieges.
- **1678** French King Louis XIV appoints Vauban his commissioner-general of fortifications, embarking on a large-scale programme of fortress-building around the frontiers of France.
- **1685** Van Coehoorn publishes his influential treatise entitled *New Fortress Construction*.
- **1692** Vauban conducts the Siege of Namur (see pp.180–81), in which van Coehoorn directs the defence; the fortress falls to the French in five weeks.
- **1695** After a two-month siege conducted by van Coehoorn, the Grand Alliance retakes Namur from the French.

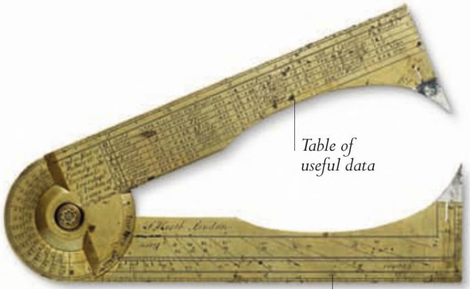
FIELD AND SIEGE ARTILLERY

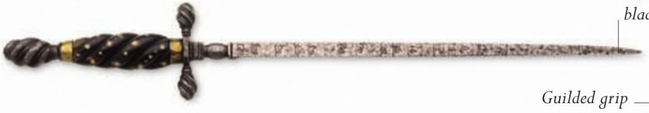
Through the 17th and 18th centuries, artillerymen continued to use smoothbore cast-bronze and cast-iron firing stone or cast-iron shot. The next breakthrough in artillery design came in the mid-19th century with the development of rifled cannon, improved gunpowder, elongated projectiles, and special instruments. While guns fired in a level trajectory, the lighter, short-barrelled mortar was used to fire in an elevated trajectory – generally more than 45 degrees. Smaller hand mortars were also developed for firing fuzed grenades. These are often named after the Dutch military engineer Menno, baron van Coehoorn, who developed a design for this weapon.

▶ GUNNER'S CALLIPERS

Date	18th century
Origin	England

Callipers were used to measure the diameter of the cannonball. When the two arms were crossed over, they could also make internal measurements, such as that of the cannon's bore.

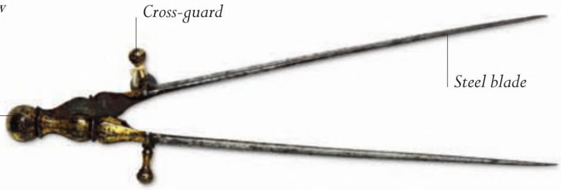




▲ GUNNER'S STILETTO

Date	18th century
Origin	Italy
Weight	150g (5½oz)
Length	34cm (13½in)

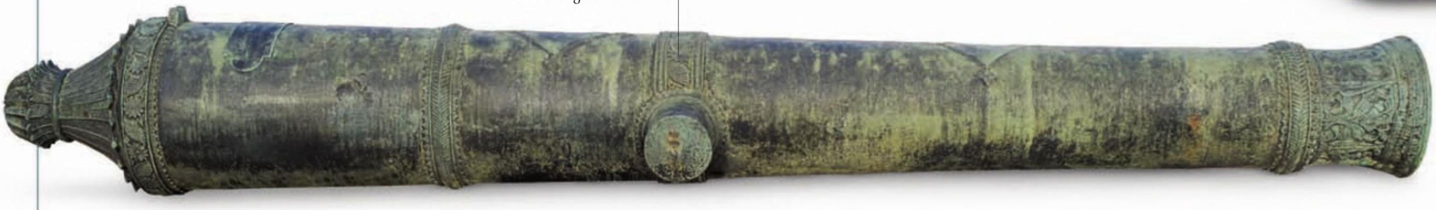
Artillerymen used this specialist dagger for measuring the bore of the gun and the size of the shot. It could also be used for self-defence in close-quarters combat.



▲ GUNNER'S DIVIDERS

Date	18th century
Origin	England
Length	44cm (17¼in)

Dividers were used with a rule to perform calculations on the proportions of fortifications. This steel pair has a cross-guard, indicating they could also be used as a dagger if the artillery position came under attack.



▲ INDIAN 6-POUNDER

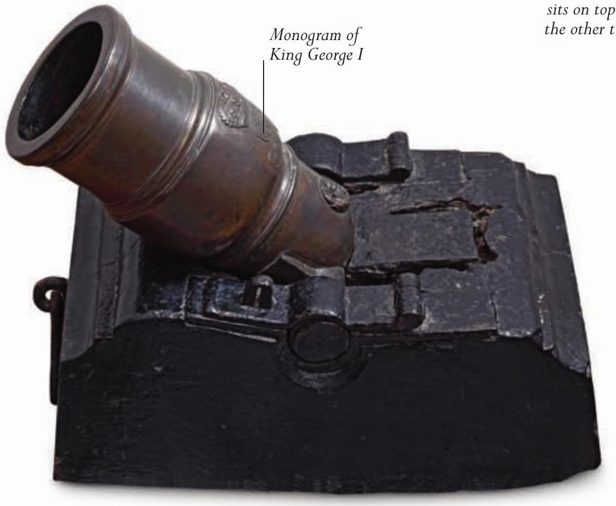
Date	1693–1743
Origin	India
Weight	3.4 tonnes (3.7 tons)
Length	3.86m (12½ft)
Calibre	9.5cm

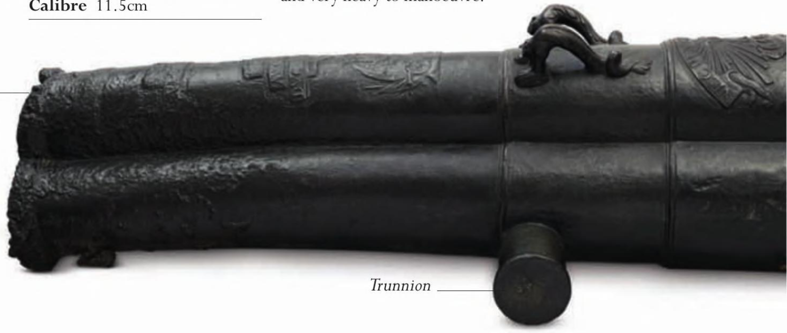
The bore of this gun is sleeved with an iron tube made from parallel strips welded together. This made the gun and the bore more durable, especially when the gun was used to fire stone shot.

▼ BRONZE THREE-BARRELLED GUN

Date	1704
Origin	France
Weight	905kg (1,996lb)
Length	1.62m (5¼ft)
Calibre	11.5cm

Three barrels, two side by side with the third above, were cast in one piece and could be fired one at a time or simultaneously. The intriguing design did not prove successful in practice, because the gun was difficult to reload and very heavy to manoeuvre.

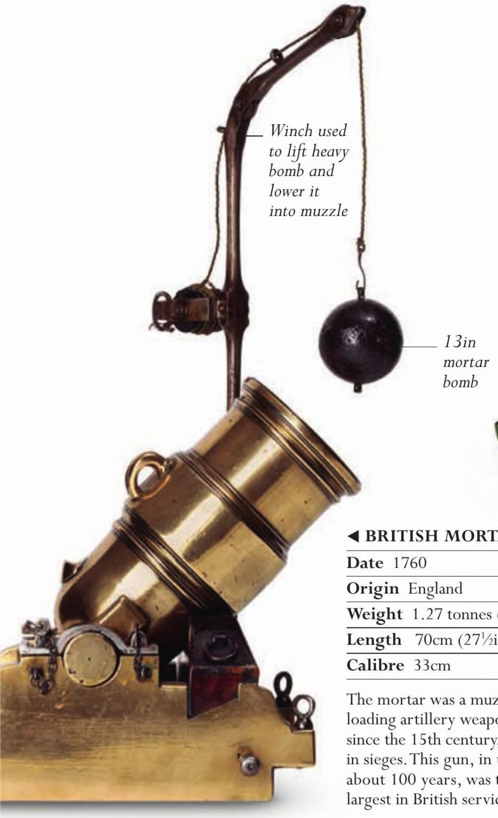




◀ COEHOORN MORTAR

Date	c.1720
Origin	England
Weight	39kg (86lb)
Length	32cm (12½in)
Calibre	4.5in

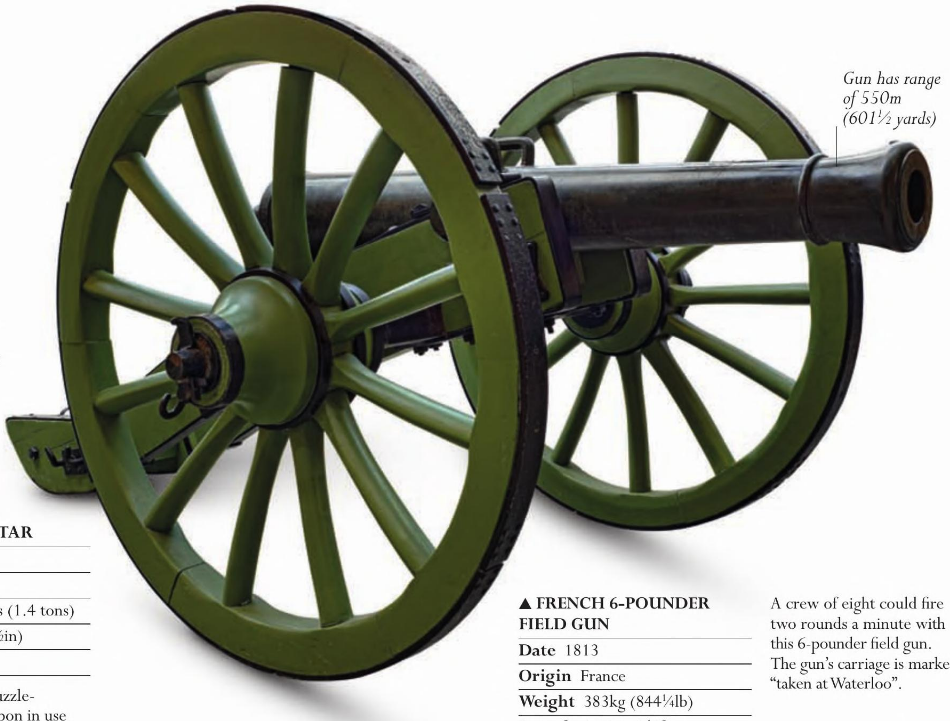
The Coehoorn mortar was a small, portable mortar used to despatch grenades. Swiss-born Andrew Schalch, first Master Founder of the Royal Brass Foundry at Woolwich in England, cast this one. It is mounted on its original wooden bed, which is just 30cm (12in) wide and 51cm (20in) long.


Winch used to lift heavy bomb and lower it into muzzle
13in mortar bomb

◀ BRITISH MORTAR

Date	1760
Origin	England
Weight	1.27 tonnes (1.4 tons)
Length	70cm (27½in)
Calibre	33cm

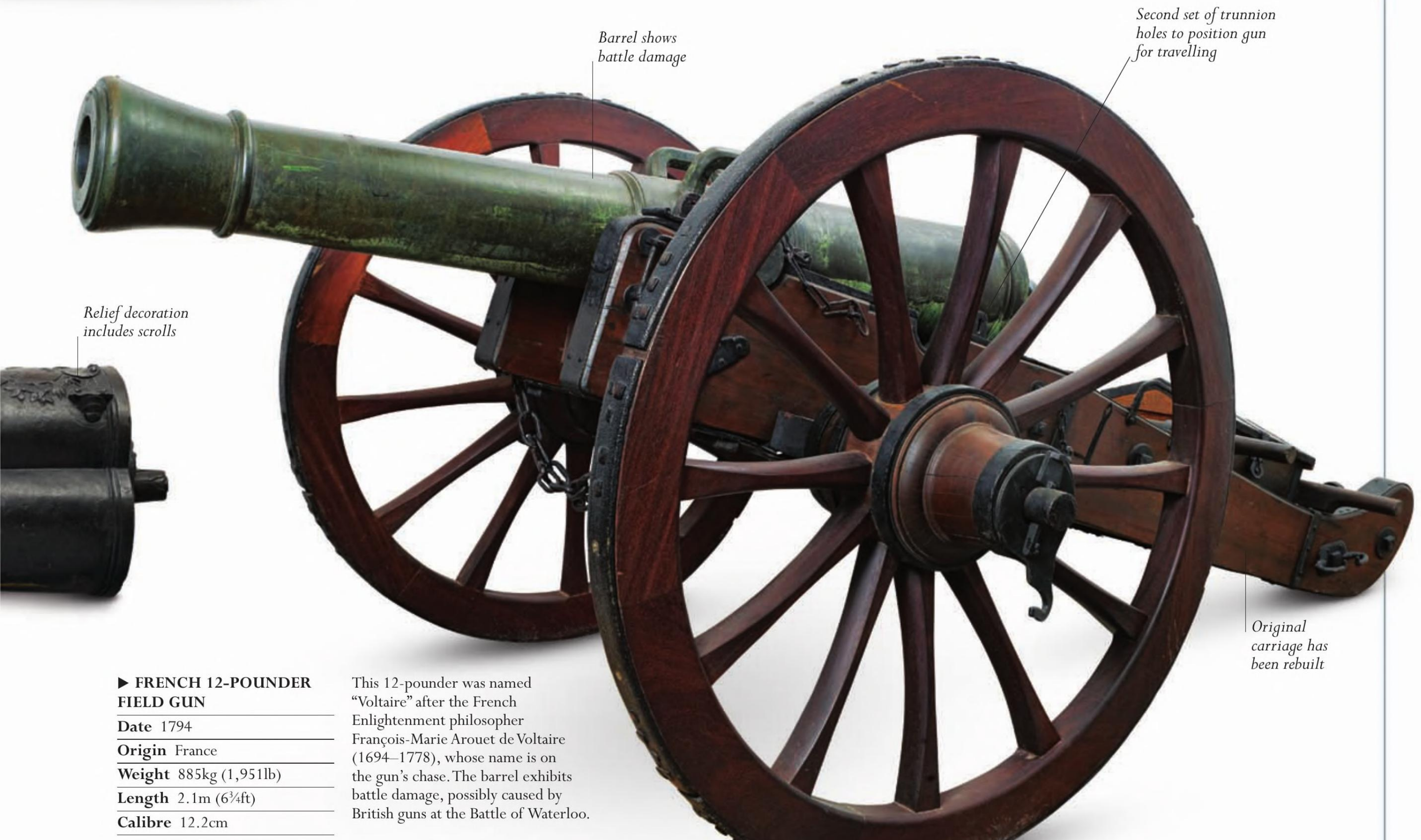
The mortar was a muzzle-loading artillery weapon in use since the 15th century, especially in sieges. This gun, in use for about 100 years, was the largest in British service.


Gun has range of 550m (601½ yards)

▲ FRENCH 6-POUNDER FIELD GUN

Date	1813
Origin	France
Weight	383kg (844¼lb)
Length	1.68m (5½ft)
Calibre	9.6cm

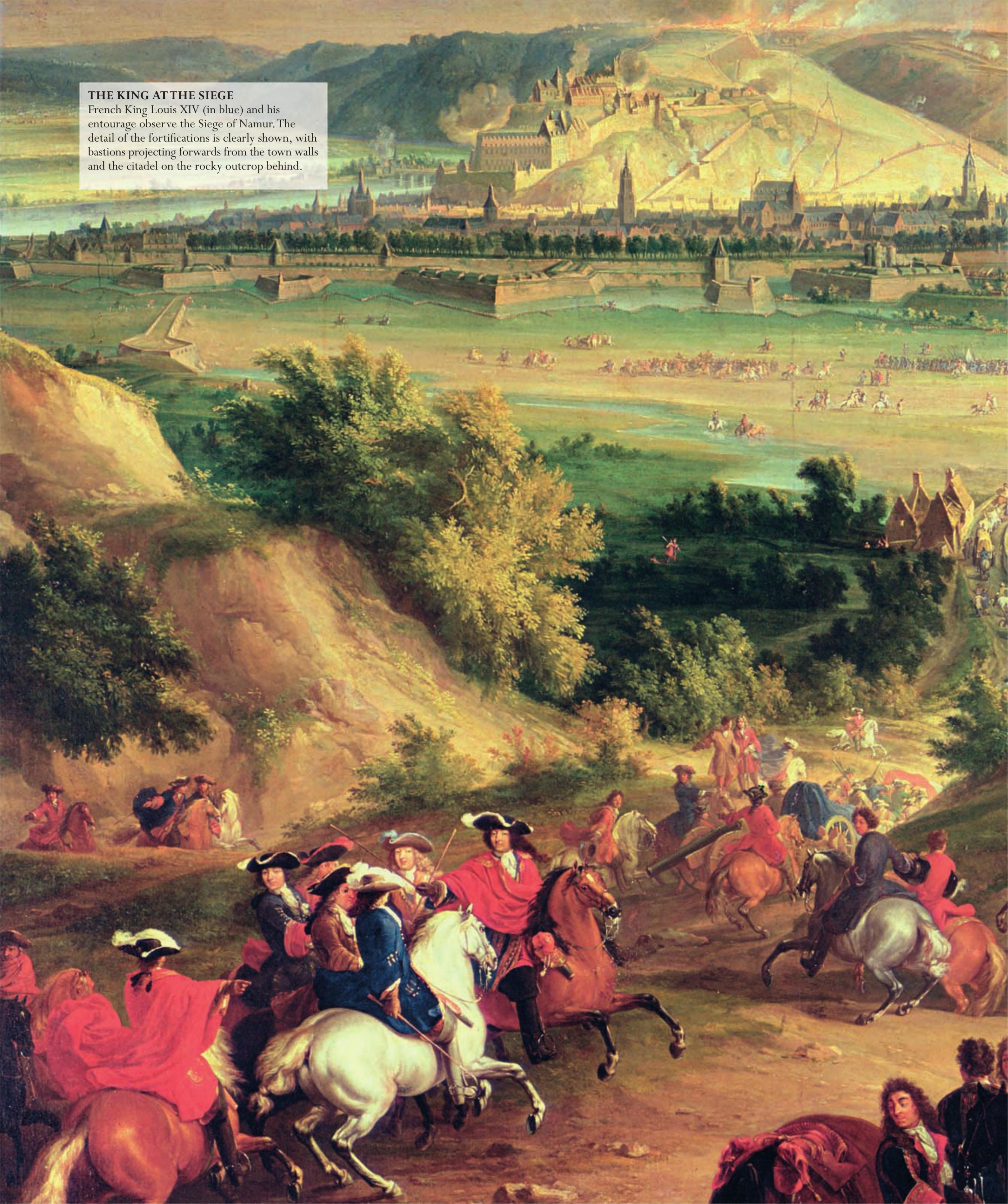
A crew of eight could fire two rounds a minute with this 6-pounder field gun. The gun's carriage is marked "taken at Waterloo".


Barrel shows battle damage
Second set of trunnion holes to position gun for travelling
Relief decoration includes scrolls
Original carriage has been rebuilt

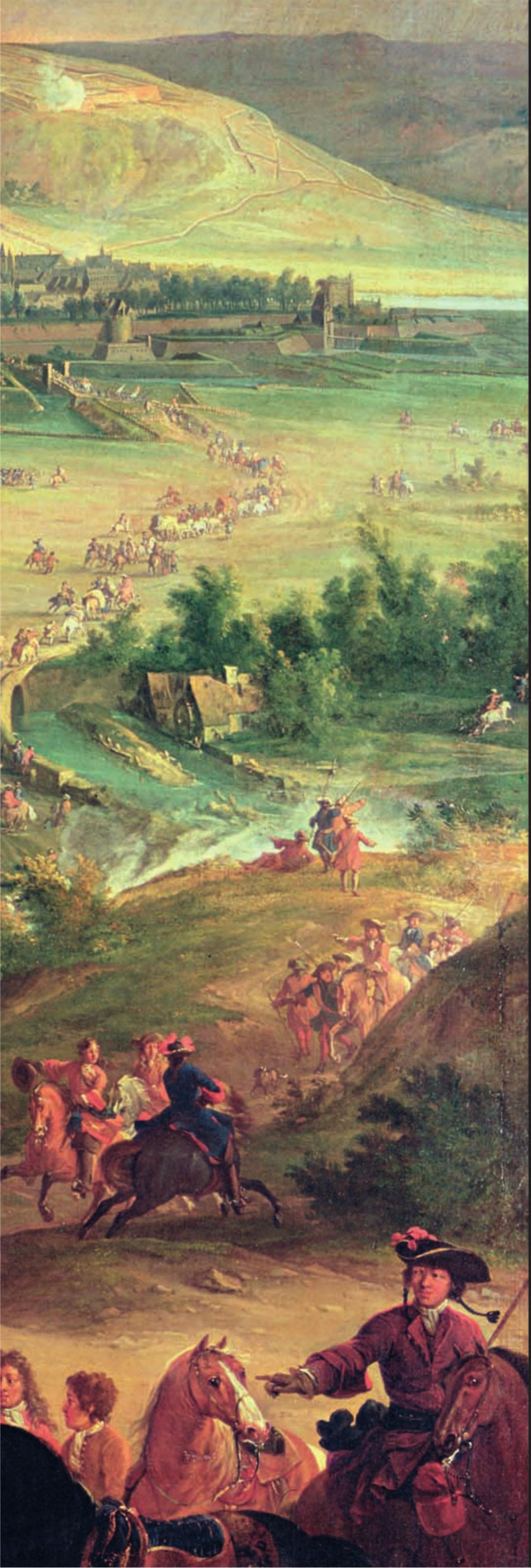
▶ FRENCH 12-POUNDER FIELD GUN

Date	1794
Origin	France
Weight	885kg (1,951lb)
Length	2.1m (6¾ft)
Calibre	12.2cm

This 12-pounder was named "Voltaire" after the French Enlightenment philosopher François-Marie Arouet de Voltaire (1694–1778), whose name is on the gun's chase. The barrel exhibits battle damage, possibly caused by British guns at the Battle of Waterloo.



THE KING AT THE SIEGE
French King Louis XIV (in blue) and his entourage observe the Siege of Namur. The detail of the fortifications is clearly shown, with bastions projecting forwards from the town walls and the citadel on the rocky outcrop behind.



EARLY MODERN SIEGE WARFARE

THE SIEGE OF NAMUR

During French King Louis XIV's reign (1643–1715), sieges were the most characteristic operations in European warfare. The Siege of Namur in 1692 is a famous example of this formalized combat, which was led by military engineers who designed the fortifications and also conducted the sieges.

Namur in Flanders was a strongpoint of the Grand Alliance (comprising the British, Dutch, Austrians, and Spanish), opponents of the French during the Nine Years' War. The fortified town stood on a plain on the north bank of the River Sambre; the citadel – an elaborate complex of fortifications – was set on rocky heights behind the town, on the south bank of the river.

In May 1692, King Louis came to witness his army's siege of Namur, led by his master engineer, the Marquis de Vauban. The fortress's defence was organized by Vauban's rival, Dutch engineer Menno van Coehoorn.

Vauban followed his standard procedures: beginning on 25 May, two lines of earthworks were dug encircling Namur. These were both to blockade the town and protect the French, who were encamped between the lines, against attack from an Alliance relief army. Then, within this encirclement, men dug lines of zig-zag trenches, or saps, toward the weakest point of the fortification. At intervals a transverse trench, or parallel, was dug and positions created for gun batteries. The cannon were then moved forward to the parallel, thus steadily advancing toward the fortress. The initial aim of the French batteries was to clear the fortifications of artillery. Vauban used ricochet fire, sending cannon balls bouncing into the defences, to force defenders to abandon their positions.

The town's low-lying fortifications, fronted by a ditch and a glacis (a slope at the fortification's base), offered a minimal target while giving defenders a clear field of fire: the French troops in their trenches were bombarded by explosive shells lobbed by high-trajectory mortars and howitzers. Despite heavy fire, the French trenches were able to be dug close enough for troops to batter a breach in the walls with their siege guns; once the breach was opened, the defenders negotiated the surrender of the town.

THE FIGHT FOR THE CITADEL

The siege was not over, however, for the garrison withdrew to the citadel, where the fighting resumed in earnest. Under the surrender terms the French agreed not to attack the citadel from the side nearest the town, where the defences were weakest. Instead they had to overcome an elaborate series of outworks fronting the main citadel.

Coehoorn directed the defence of the strongest of these, Fort William, in person. While Vauban dug his saps and parallels, French mortars bombarded the defenders with explosive shells launched over the walls. On 22 June, after a French infantry assault, Coehoorn surrendered the fort and was taken prisoner. The main citadel, however, remained unbreached.

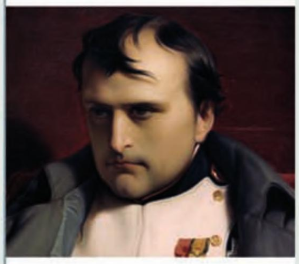
The French, meanwhile, had run into supply difficulties: without sufficient fodder, their many thousands of horses began to starve. Persistent wet weather had also turned the ground to a quagmire and carts trying to bring heavy ammunition up to the batteries foundered. It was a profound relief to Vauban and his king when the citadel's defences were breached with sudden ease – possibly through an act of betrayal from within the garrison, which somehow left a section of the fortifications undefended. The garrison formally capitulated on 30 June and was granted the honours of war, marching out with drums beating and banners flying.

KEY **FIGURE**

NAPOLEON BONAPARTE

1769–1821

Born in Corsica, Napoleon was an artillery officer who became the most charismatic general in the French Revolutionary armies. In 1799, he seized power in a military coup, declaring himself Emperor in 1804. Defeated at Waterloo in 1815, he died a prisoner of the British.



▲ An aggressive risk-taker, Napoleon used cavalry and artillery as shock forces on the battlefield. He fought 50 battles, winning most of them.

KEY DEVELOPMENT

ARMIES OF THE REVOLUTIONARY ERA

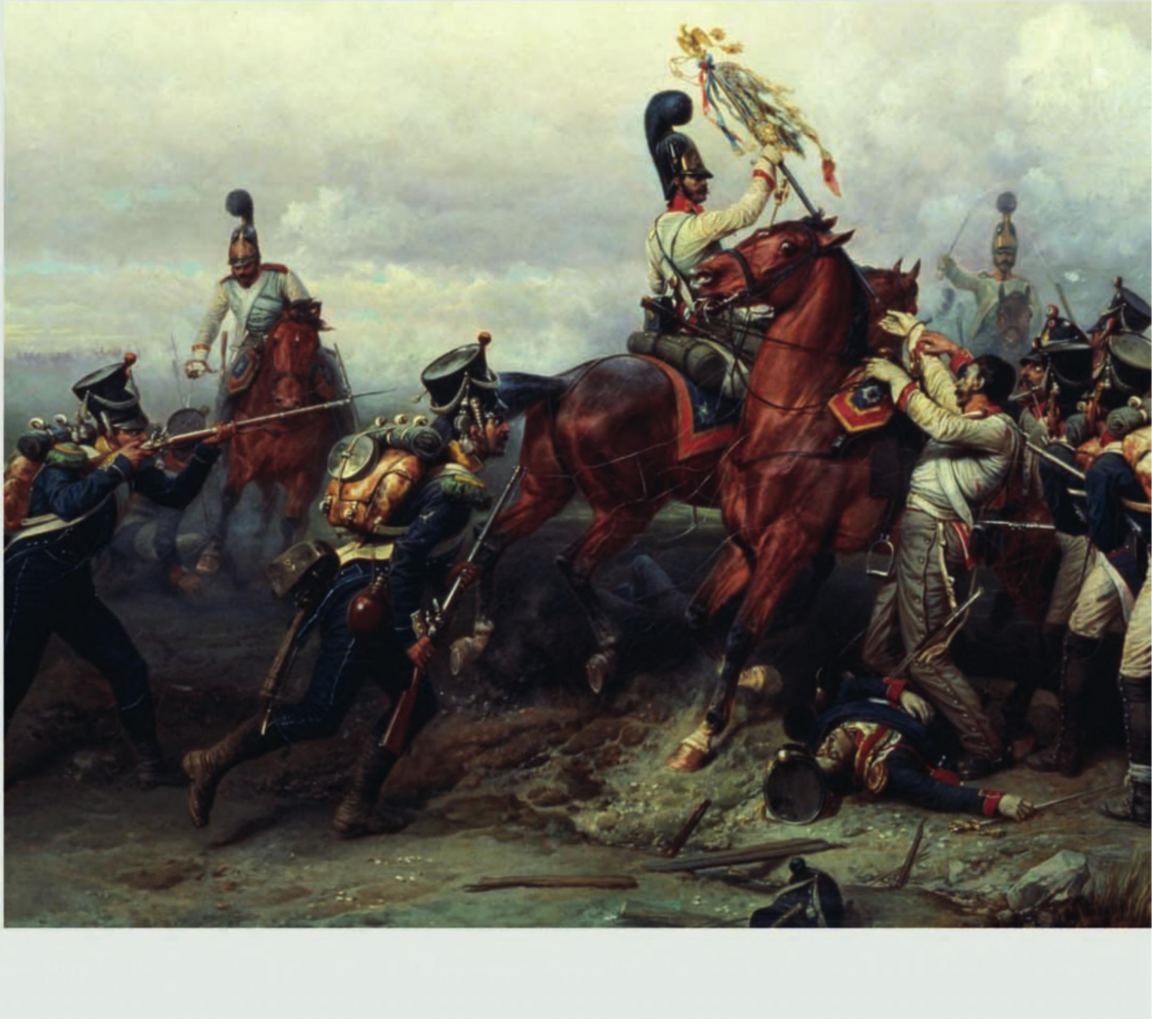
The French Revolution of 1789 ushered in a new era of mass citizen armies, with battles fought on an unprecedented scale. The military genius of French emperor Napoleon Bonaparte, meanwhile, whose empire grew out of the revolution, gave European warfare a fresh dynamism.

From 1792 to 1815, the French Revolutionary Wars and the Napoleonic Wars kept Europe in an almost continuous state of warfare. There were a number of technological innovations during this period, some of which had an impact on the battlefield. The Chappe telegraph system, introduced by the French, in 1792 allowed messages to be sent rapidly over long distances via a chain of visual semaphore signalling stations – an invention of great value for military commanders. Meanwhile in 1794, at the Battle of Fleurus, the French also experimented with the use of a manned balloon for reconnaissance – the first ever instance of aerial warfare. Elsewhere, the British adopted shrapnel shells as anti-personnel munitions, and Congreve rockets as auxiliary artillery. However, the impact of these innovations was overshadowed by the changes that took place in military organization and tactics.

THE LEVÉE EN MASSE

In 1793, threatened with invasion by a coalition of hostile powers, the revolutionary French Republic issued a call for a *levée en masse* – the conscription

▸ **THE BATTLE OF AUSTERLITZ** The mounted Russian Imperial Guard, flourishing their sabres, clash with Napoleon's infantry, armed with musket and bayonet, at Austerlitz in 1805.



KEY **EVENTS**

1792–1815

- **1792** The French Revolutionary Wars begin, with a declaration of war against Austria.
- **1793–94** Lazare Carnot, war minister of the French Republic, orders mass conscription, raising an army of around one and a half million soldiers.
- **1805–06** Victories over the Austrian and Russian armies at Austerlitz, and the Prussians at Jena-Auerstadt, establish the dominance of Napoleon's Grande Armée.
- **1807** Prussia reforms its armed forces by mass conscription, ending corporal punishment, and adopting combined arms tactics.
- **1812** Napoleon invades Russia with an army of half a million men; about one in five of these survive the army's retreat from Moscow.
- **1815** Napoleon is defeated at Waterloo by a British army under the Duke of Wellington, and the Prussian army of Field Marshal Gebhard Leberecht von Blücher.

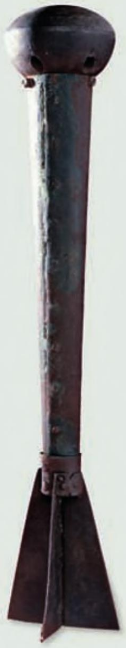
> "They came upon us **crying and shouting**, to the very **point of our bayonets**"
>
> **BRITISH OFFICER CAPTAIN THOMAS POCOCKE**, DESCRIBING THE FRENCH AT VIMIERO, 1808

of all able-bodied men under 25. It was an appeal for what would later be called "total war": the rest of the population was to devote itself to supporting the war effort. The citizen-soldiers were expected to fight out of devotion to the nation and the revolution – rather than through fear of the lash and the gallows – and the officer ranks, previously monopolized by the aristocracy, were opened up to competent soldiers of all social backgrounds.

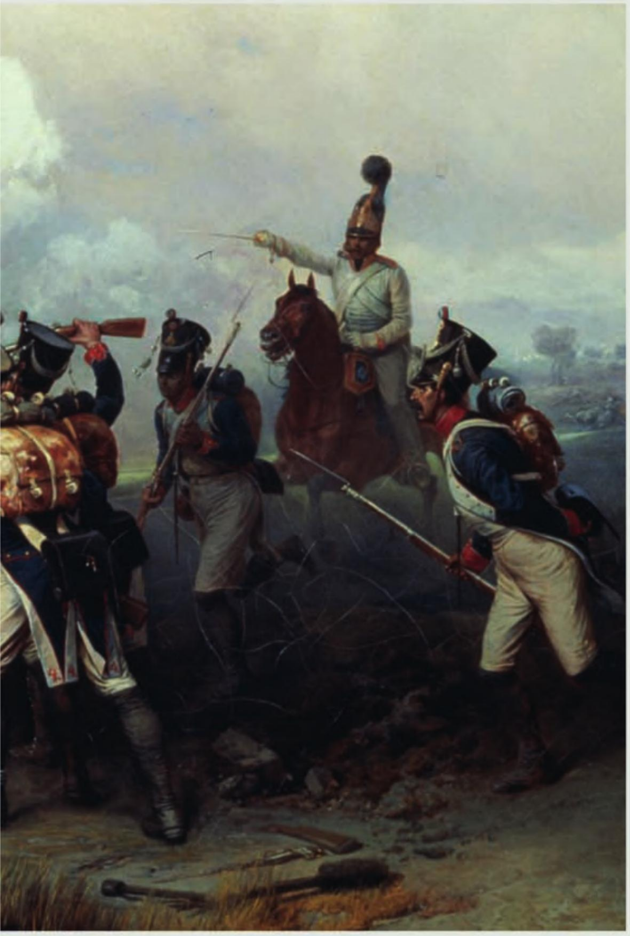
THE GRANDE ARMÉE

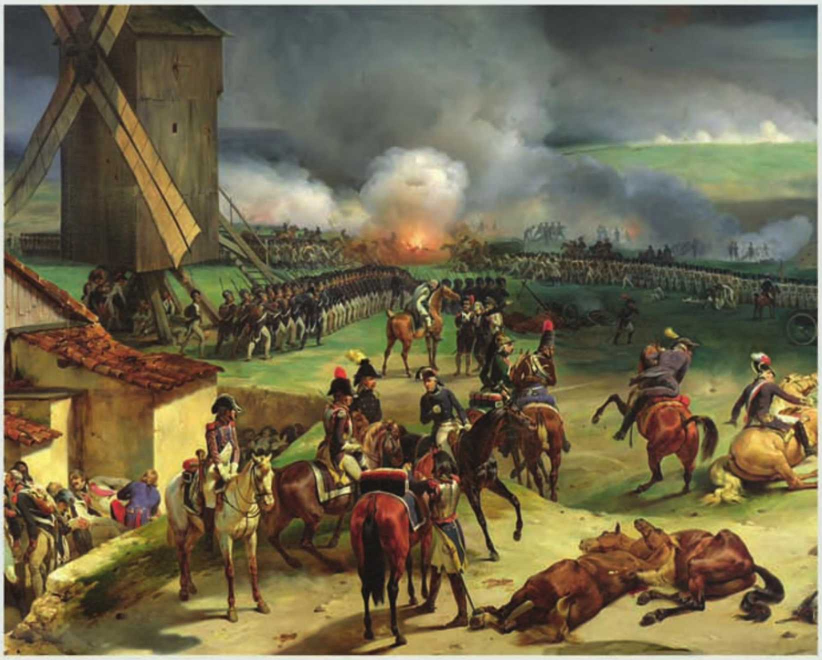
The new political climate brought about by the French Revolution transformed France into an expansionist power. Napoleon Bonaparte established himself as the country's most popular general and then became, in effect, a military dictator. By 1805, he had built the "Grande Armée", an army divided into six all-arms corps, each capable of independent manoeuvre. Freed from reliance on a supply train by living off the land, Napoleon moved his army at speed to bring the enemy to battle and destroy them. On the battlefield he emphasized the attack: musket-armed infantry advanced in dense columns preceded by swarms of skirmishers, and the cuirassiers (armoured heavy cavalry) mounted massed charges. Gunners deployed cannon aggressively – Napoleon regarded the artillery as potential battle-winners, rather than a mere support to infantry and cavalry.

France's enemies took time to adjust to this new scale and dynamism, but over time they mobilized resources in their own version of total war. In Spain from 1808, and later, in Russia in 1812, France was defeated by relentless resistance, in the form of guerrilla warfare and pitched battles. At Leipzig in 1813, in the largest battle Europe had ever seen, Napoleon commanded an army of 200,000 men, but was outnumbered by two-to-one. With mass conscription and ever-improving weapons, this was the era that saw European societies begin a path to militarization – one that would bear bitter fruit in the world wars of the 20th century.



▲ THE CONGREVE ROCKET
Inspired by the rocket artillery of the Indian kingdom of Mysore, the British Congreve rocket was propelled by black powder and had an explosive warhead.

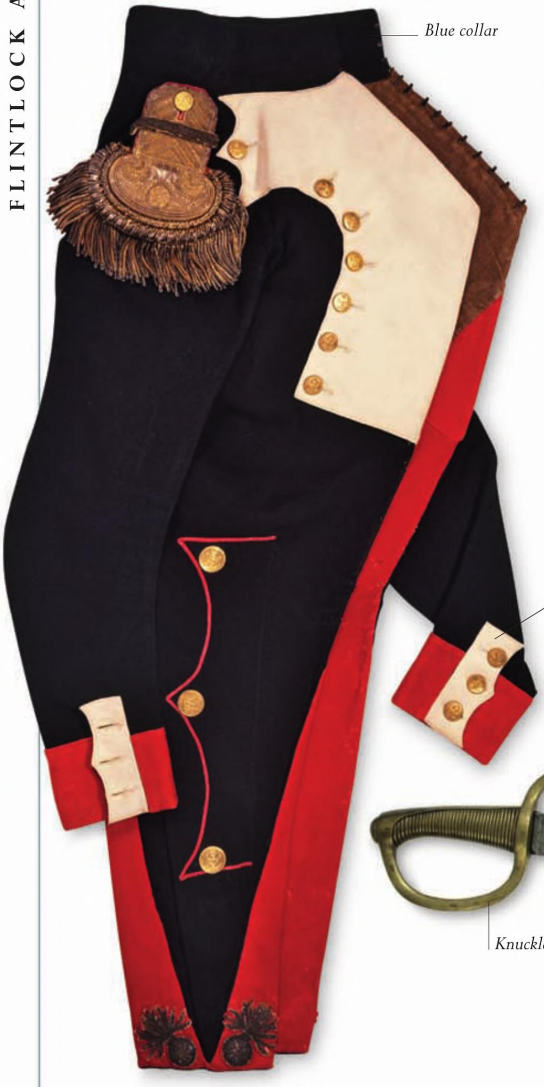




▼ THE BATTLE OF VALMY
The first battle of the French Revolutionary Wars, fought in September 1792, was a victory for French artillery defending the heights of Valmy.

FRENCH REVOLUTIONARY AND NAPOLEONIC INFANTRY

Infantrymen in the French Revolutionary and Napoleonic Wars fought mainly with smoothbore flintlock muskets and bayonets, and most of them also carried a sword. Their white trousers and coat were complemented by a "shako", or hat, complete with regimental badge and pompom. The infantry comprised fusilier companies fighting alongside grenadiers – the senior infantry regiment, who were particularly well kitted out – and, after 1805, *voltigeurs* (shorter soldiers who specialized in skirmishing and scouting). The troops of Napoleon's "Grande Armée" were celebrated not only for their discipline, courage, and devotion, but also for their ornate uniforms.



◀ GRENADIER OFFICER'S COAT

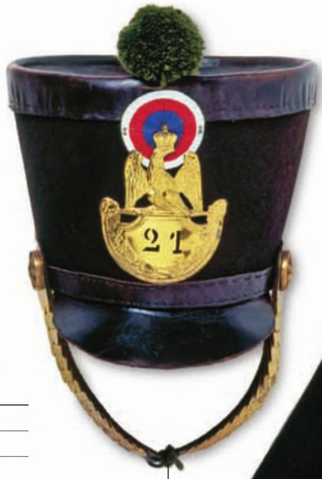
Date c.1810
Origin France
Material Wool, linen

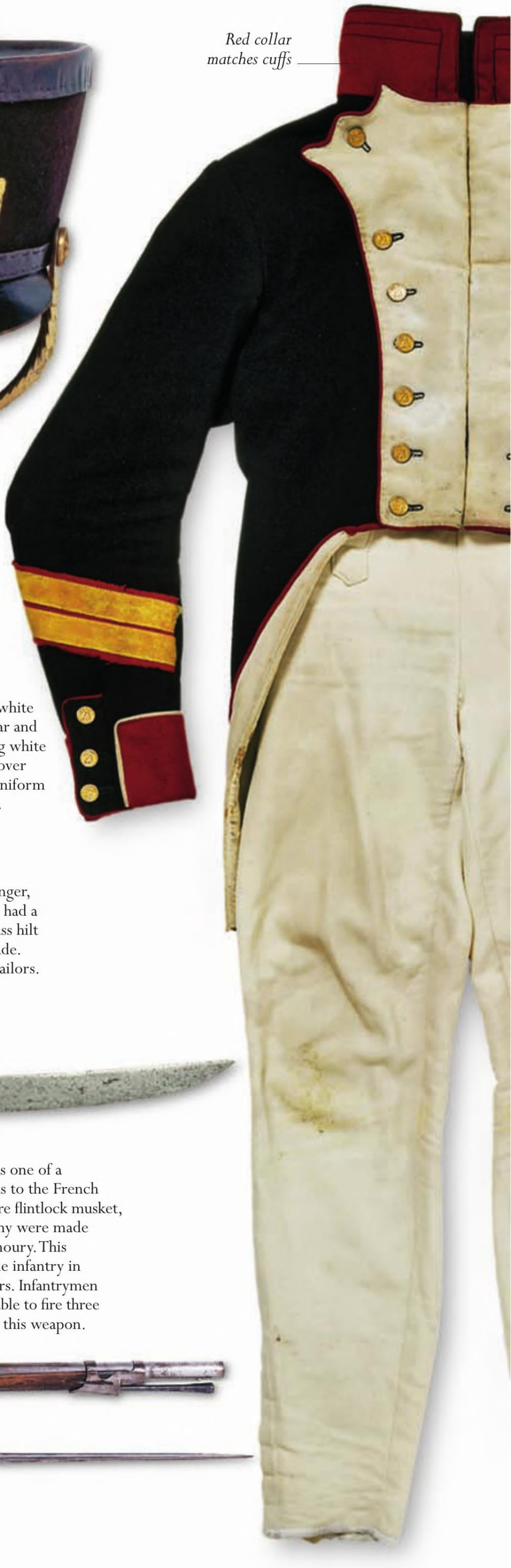
This coat was worn by an officer in the Grenadier infantry in Napoleon's Imperial Guard. French soldiers referred to the Imperial Guard as "the Immortals". They had better equipment, rank, and quarters than their counterparts in the main army.

▼ INFANTRYMAN'S SHAKO

Date 1806
Origin France
Material Felt, leather

The shako replaced the earlier bicorn hat of the French infantry in 1806. On this shako, the front plate bears the imperial eagle and the regimental number, as well as a tricolour cockade.





▶ NAPOLEONIC INFANTRY UNIFORM

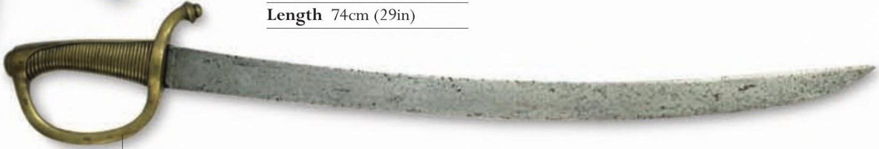
Date c.1810
Origin France
Material Wool, linen

The Napoleonic infantryman wore a dark blue tunic with white facings and a red collar and cuffs. The loose-fitting white trousers were worn over knee breeches. This uniform has corporal's stripes.

▼ NAPOLEONIC INFANTRY SWORD

Date c.1800
Origin France
Weight 900g (31¾oz)
Length 74cm (29in)

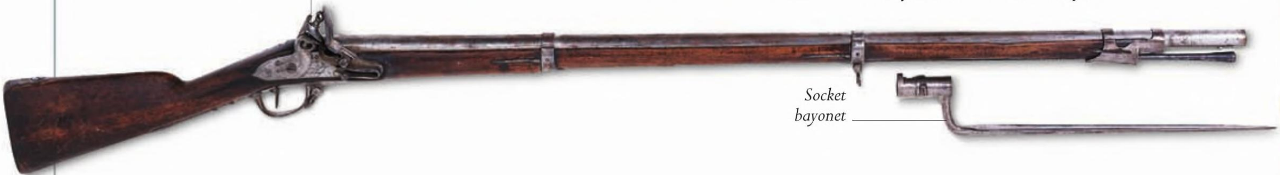
The infantryman's hanger, known as a "briquet", had a simple, one-piece brass hilt and a curved steel blade. It was also issued to sailors.



▼ CHARLEVILLE MODÈLE 1777

Date 1777
Origin France
Weight 4.5kg (10lb)
Barrel 1.13m (3¾ft)
Calibre 17.5mm

The Modèle 1777 was one of a series of modifications to the French Charleville smoothbore flintlock musket, so-called because many were made at the Charleville armoury. This model was used by the infantry in the Revolutionary Wars. Infantrymen were expected to be able to fire three volleys a minute with this weapon.



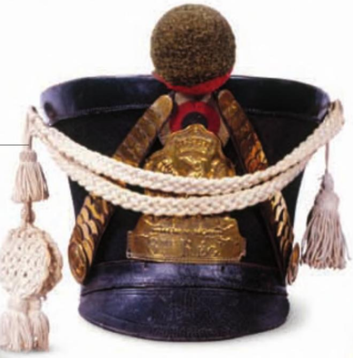
▼ PARADE SHAKO

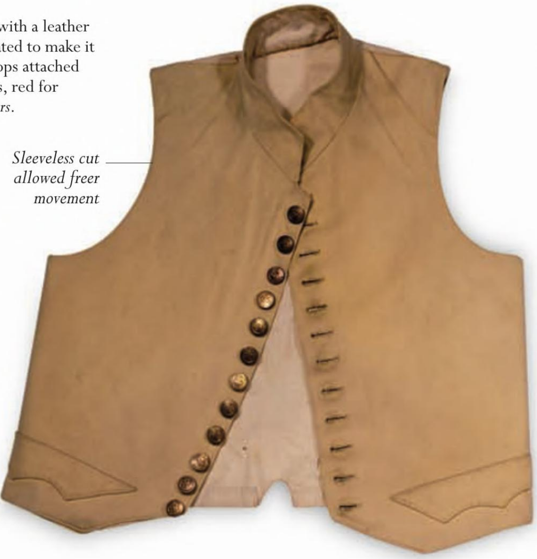
Date 1806

Origin France

Material Felt, leather

Made of felt or sometimes board with a leather peak, the top of the shako was treated to make it waterproof. When on parade, troops attached cords to them – white for fusiliers, red for grenadiers, and yellow for *voltigeurs*.


White cords for fusilier companies


Sleeveless cut allowed freer movement

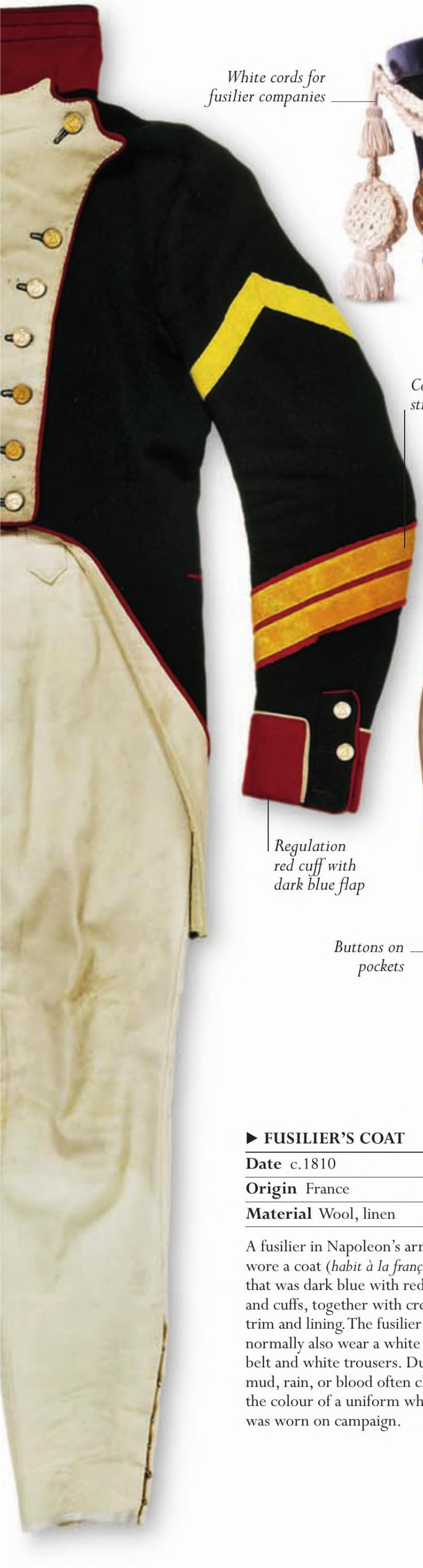
◀ FUSILIER'S WAISTCOAT

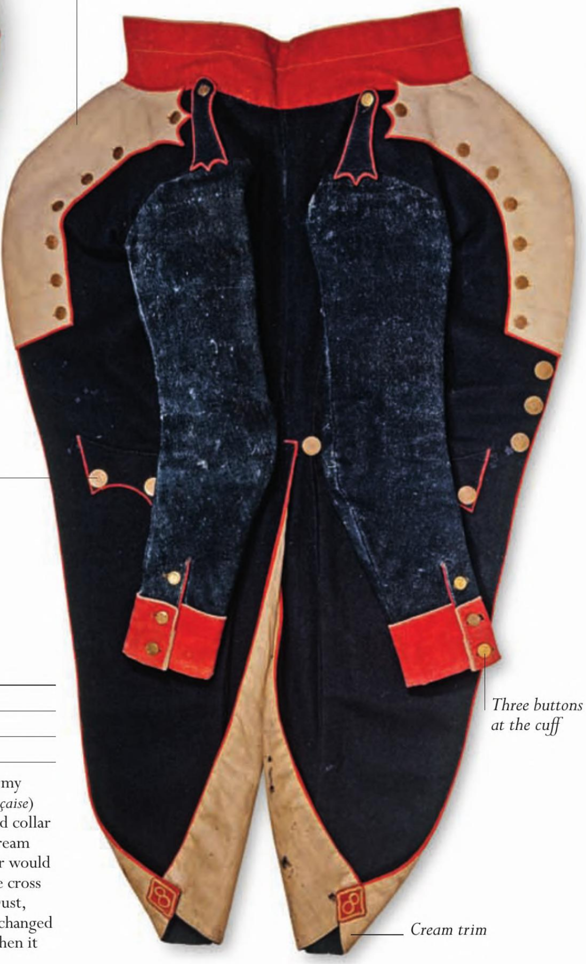
Date c.1810

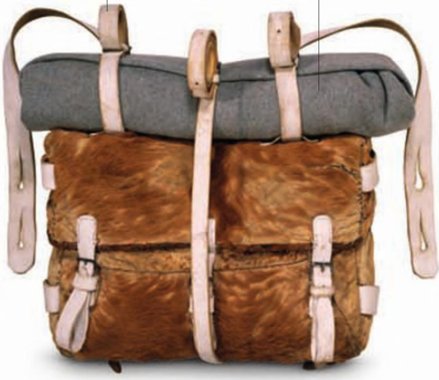
Origin France

Material Leather

Waistcoats – also known as undercoats – came in a range of colours and materials. Fusiliers often wore white. On hot days, soldiers sometimes took off their coats and fought in waistcoats.


Corporal's stripes
Regulation red cuff with dark blue flap


White lapels often treated with pipe clay
Buttons on pockets
Three buttons at the cuff
Cream trim


Leather straps were whitened with clay
Rolled-up greatcoat

▲ SOLDIER'S PACK

Date c.1810

Origin France

Material Leather

The soldier's compact knapsack was used for storing extra clothing and rations of bread. Held securely in position by its shoulder straps, the top of the pack also featured stowage points for carrying the soldier's greatcoat.

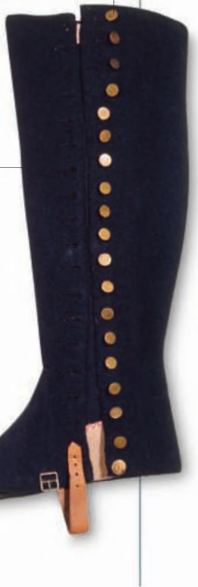
▶ FUSILIER'S COAT

Date c.1810

Origin France

Material Wool, linen

A fusilier in Napoleon's army wore a coat (*habit à la française*) that was dark blue with red collar and cuffs, together with cream trim and lining. The fusilier would normally also wear a white cross belt and white trousers. Dust, mud, rain, or blood often changed the colour of a uniform when it was worn on campaign.


Buttons for fastening over uniform
Leather covering kept lower legs dry

▶ FUSILIER'S GAITERS

Date c.1810

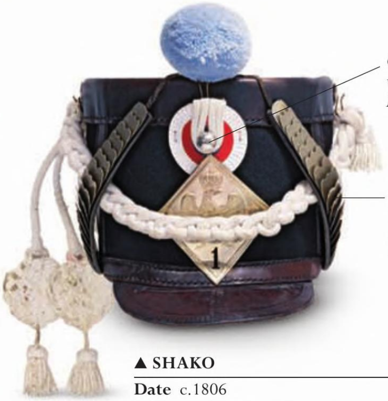
Origin France

Material Leather

Gaiters kept dirt and stones out of the soldier's shoes, which often did not fit very well. French military gaiters were often made long, to be worn over the knee, but soldiers cut them down to wear them below the knee.

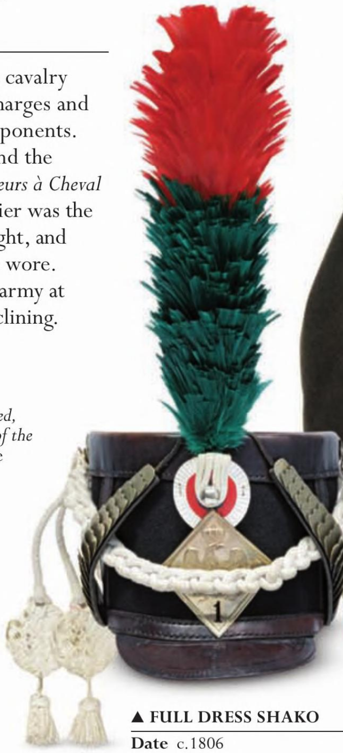
UNIFORMS OF CHASSEUR AND CUIRASSIER

Napoleon Bonaparte (see p.182) relied on his light cavalry (chasseurs) and heavy cavalry (cuirassiers) to mount charges and press home a decisive advantage in pursuing routed opponents. These are examples of the uniforms of the chasseurs and the cuirassiers. The chasseur uniform is that of the *1er Chasseurs à Cheval de la Ligne, 2e Compagnie*, from around 1806. The cuirassier was the descendant of the mounted and armoured medieval knight, and took his name from the *cuirasse* (armour breastplate) he wore. Napoleon found an important role for cuirassiers in his army at a time when the use of armoured heavy cavalry was declining.



Cockade in the red, white, and blue of the French tricolore

Chinscales, tied behind shako when not in use



▲ SHAKO

Date c.1806

Origin France

Material Felt, leather

The shako was adopted by many European cavalry and infantry regiments in the late 1700s. This chasseur shako had a waterproof top and was secured under the chin by brass chinscales.

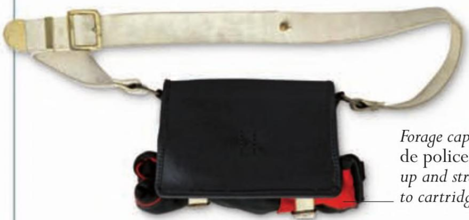
▲ FULL DRESS SHAKO

Date c.1806

Origin France

Material Felt, leather

When on parade, the chasseur wore a plume on his shako instead of the pompom he wore when in battle. This is the full dress shako of the First Regiment of Chasseurs.



Forage cap (bonnet de police) *rolled up and strapped to cartridge box*

▲ CARTRIDGE BOX

Date c.1806

Origin France

Material Leather

The chasseur carried a box of prepared cartridges for his carbine and pistols. He hung the box from a crossbelt worn over the left shoulder.

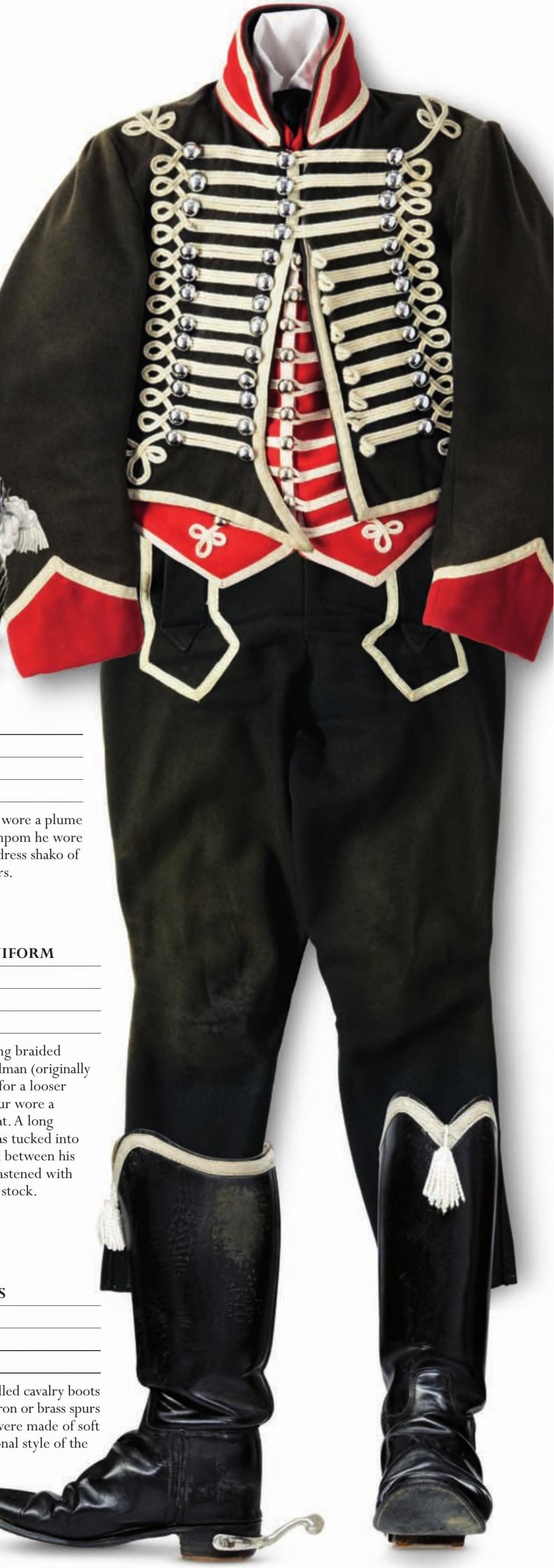
▶ BREAD BAG

Date c.1806

Origin France

Material Linen

A lightweight cloth bag was used by the chasseurs to carry rations. They were not issued with water bottles and often had their own leather wineskin.



▶ CHASSEUR UNIFORM

Date c.1806

Origin France

Material Wool

Under the tight-fitting braided jacket, known as a dolman (originally from a Turkish word for a looser garment), the chasseur wore a splendid red waistcoat. A long white cotton shirt was tucked into the breeches and tied between his legs. The collar was fastened with an unobtrusive black stock.

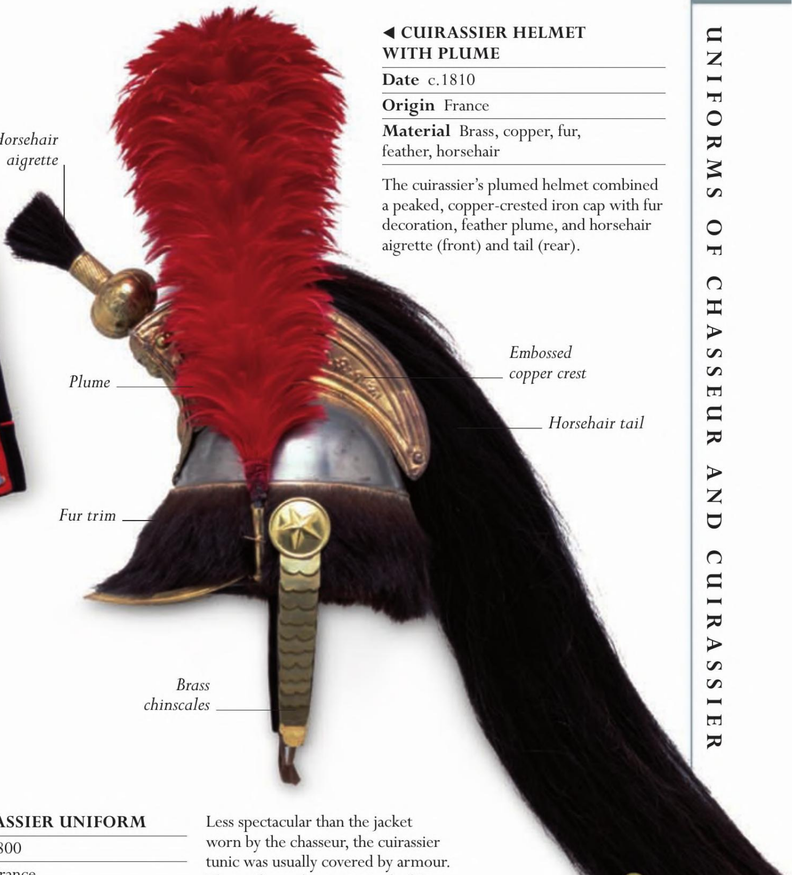
▶ RIDING BOOTS

Date c.1806

Origin France

Material Leather

The well-made, tasselled cavalry boots of the chasseurs had iron or brass spurs on them. The boots were made of soft leather in the traditional style of the Hungarian hussar.


Horsehair aigrette
Plume
Embossed copper crest
Horsehair tail
Fur trim
Brass chinscales

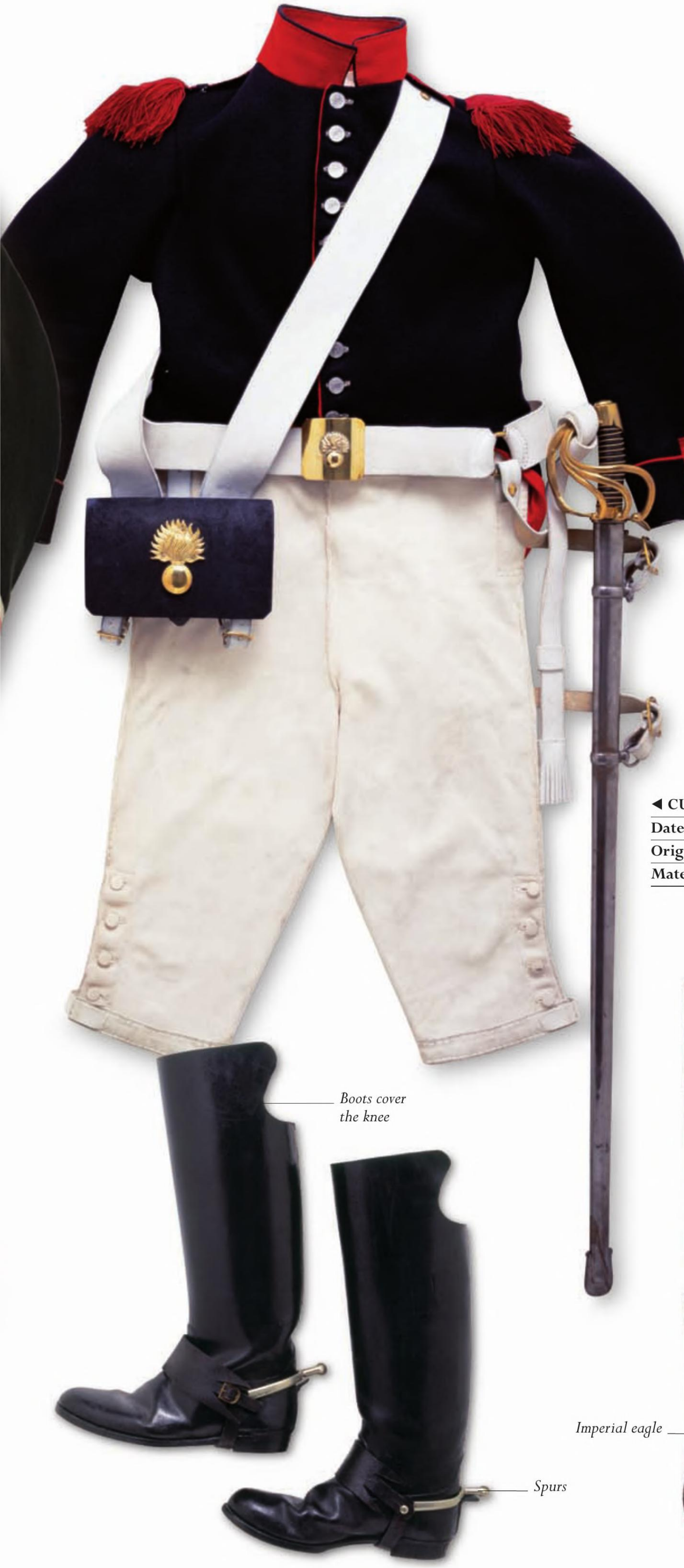
◀ CUIRASSIER HELMET WITH PLUME

Date c.1810

Origin France

Material Brass, copper, fur, feather, horsehair

The cuirassier's plumed helmet combined a peaked, copper-crested iron cap with fur decoration, feather plume, and horsehair aigrette (front) and tail (rear).


Boots cover the knee
Spurs

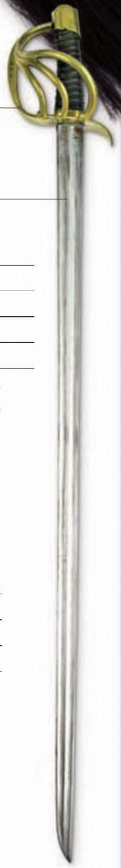
◀ CUIRASSIER UNIFORM

Date c.1800

Origin France

Material Wool, linen

Less spectacular than the jacket worn by the chasseur, the cuirassier tunic was usually covered by armour. The uniform also comprised white breeches and sturdy leather boots.


Knuckle guard with three additional branches
Steel blade with double fullers

▶ MODEL AN XIII SWORD

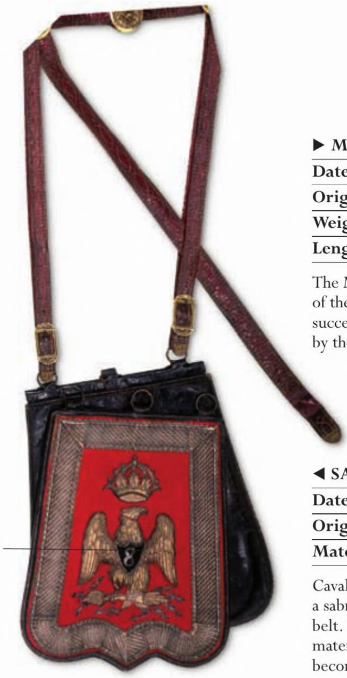
Date 1810

Origin France

Weight 3.13kg (7lb)

Length 1.12m (3½ft)

The Model An XIII Sword (from the 13th year of the French Revolutionary Calendar) was the successor to the An IV sword, and was carried by the French dragoons and heavy cavalry.


Imperial eagle

◀ SABRETACHE OF 8TH HUSSARS

Date c.1800

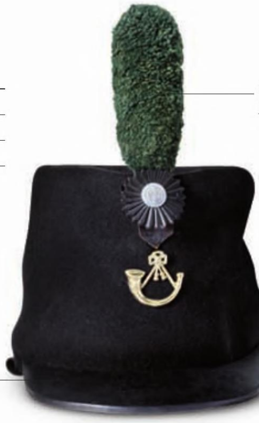
Origin France

Material Leather

Cavalrymen carried a leather satchel called a sabretache, which hung from the sabre belt. It originally held writing and sketching materials, but by Napoleonic times had become largely decorative.

BRITISH UNIFORM AND KIT OF THE NAPOLEONIC WARS

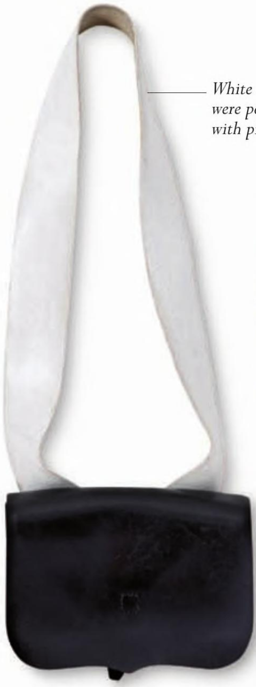
The British line and light infantry in the Napoleonic Wars wore bright red jackets. The eye-catching colour was a sensible choice in an era when visibility during battles was often severely reduced by clouds of gunpowder smoke, making it difficult to distinguish friend from foe. Infantrymen wore the "stovepipe" shako as standard from 1801 to 1812. A soldier's most important piece of equipment was the flintlock Land-Pattern musket known as "Brown Bess", but he also had to carry a haversack, food bag, kettle, greatcoat, blanket, and water canteens, as well as ammunition. This represented a heavy burden on marches of up to 25km (15 miles) a day.

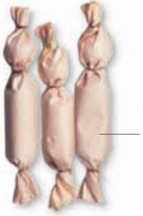


▶ GREEN-PLUMED LIGHT INFANTRY SHAKO

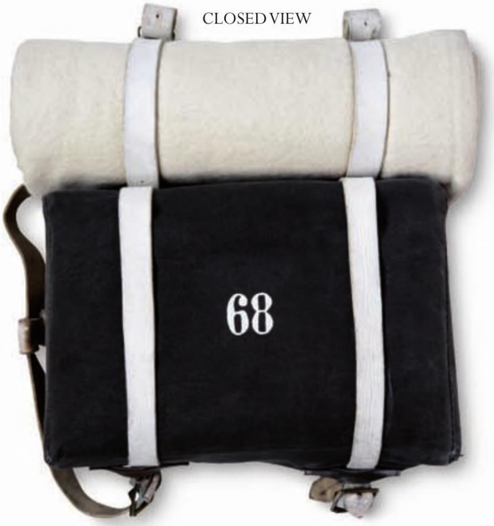
Date 1801
Origin UK
Material Felt, leather

The cylindrical British light-infantry shako was made of felt with a leather peak. The bugle-horn badge and green plume were symbols of light infantry.





CARTRIDGES



CLOSED VIEW

Lace colours specific to light infantry

▶ TUNIC

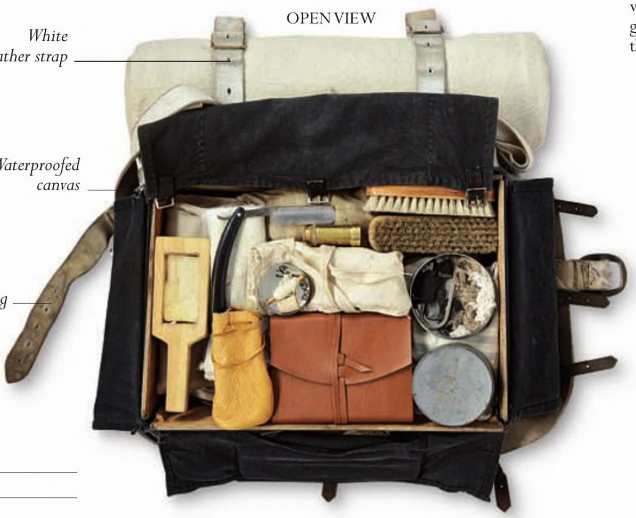
Date c.1810
Origin UK
Material Wool, linen lining

Private soldiers wore a single-breasted brick-red tunic. The green facings on the collar and cuffs and the shape, colour, and spacing of the lace were all light infantry features.

▶ TROUSERS

Date c.1810
Origin UK
Material Wool

During the Peninsular War, the light infantryman's white breeches and black gaiters gave way to the grey trousers shown here. Made of thick wool, they were stiflingly hot in summer.



OPEN VIEW

▲ CARTRIDGE POUCH

Date c.1800
Origin UK
Material Leather

The bag could hold 60 cartridges, each of which contained powder and a musket ball. The powder was used as both primer and charge, while the paper served as wadding to keep the musket ball in the barrel.

◀ MUSKET BALLS

Date c.1800
Origin UK
Weight 32gm (1oz)
Diameter 1.7cm ($\frac{3}{4}$in)

Musket balls were made of lead. Balls were classified by their "bore" – the number of balls that could be cast from 0.45kg (1lb) of lead.

▲ BRITISH LIGHT INFANTRY "TROTTER" KNAPSACK

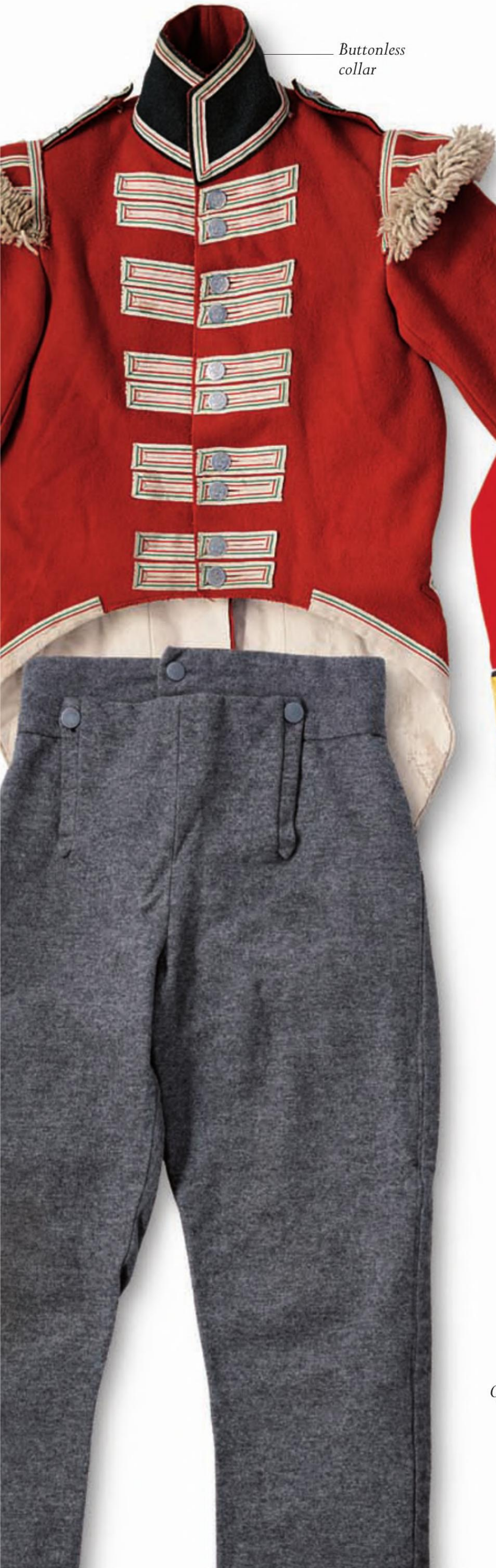
Date c.1805
Origin UK
Material Wood, canvas

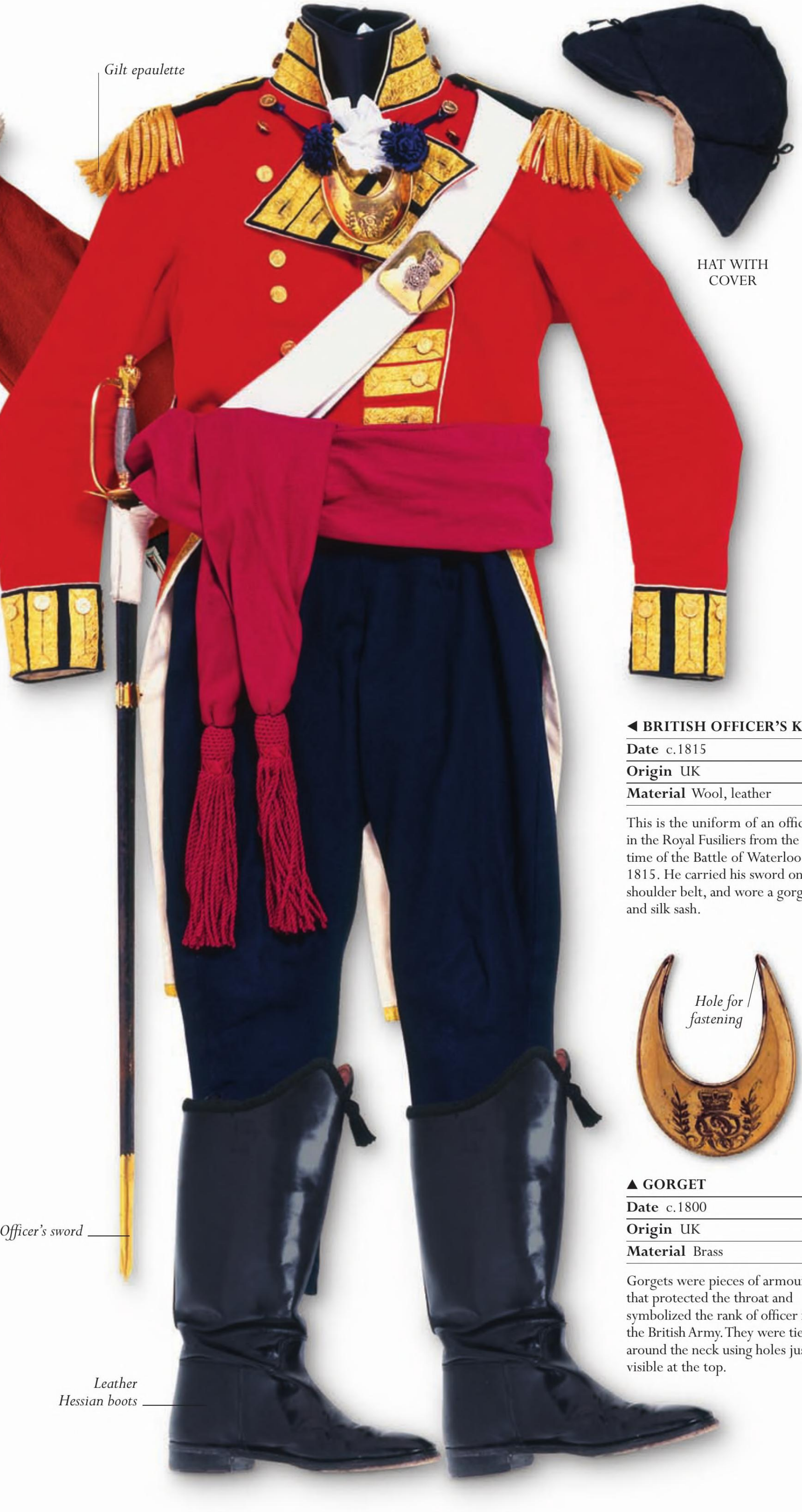
The envelope (or "Trotter") knapsack, marked with the regimental number, was introduced in around 1805 for light infantry. By 1812, it was being used across the British Army.

▲ SHOES

Date c.1800
Origin UK
Material Leather

Shoes were issued "straight-lasted" (with neither left nor right) and were often of extremely poor quality. A soldier was issued only two pairs each year.


Buttonless collar


Gilt epaulette
Officer's sword
Leather Hessian boots

HAT WITH COVER

◀ BRITISH OFFICER'S KIT

Date c.1815

Origin UK

Material Wool, leather

This is the uniform of an officer in the Royal Fusiliers from the time of the Battle of Waterloo in 1815. He carried his sword on a shoulder belt, and wore a gorget and silk sash.

Hole for fastening

▲ GORGET

Date c.1800

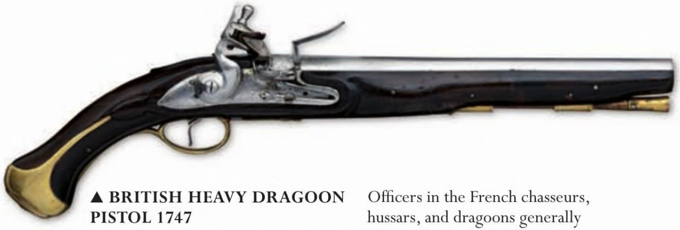
Origin UK

Material Brass

Gorgets were pieces of armour that protected the throat and symbolized the rank of officer in the British Army. They were tied around the neck using holes just visible at the top.

WEAPONS OF THE REVOLUTIONARY AND NAPOLEONIC WARS

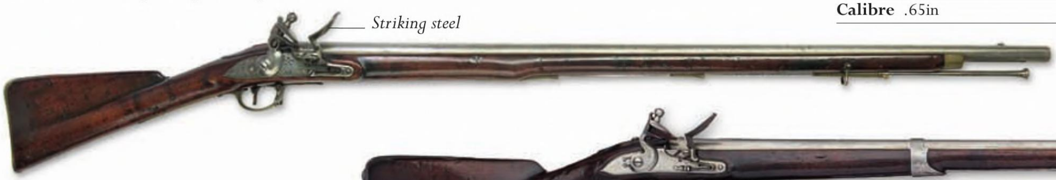
Armies in the Revolutionary and Napoleonic Wars fought with a range of weapons including bayonets and cannon. The massed infantry used muskets, and only the specialist regiments of sharpshooters carried rifles. Swords were the preferred weapon in a cavalry charge, except for light cavalry regiments, who carried lances topped with pennons or flags. Many cavalrymen also had two loaded pistols, for emergency use, while dragoons often regarded the carbine as their principal weapon.



▲ BRITISH HEAVY DRAGOON PISTOL 1747

Date 18th century
Origin UK
Weight 1.2kg (2½lb)
Barrel 30.5cm (12in)
Calibre .65in

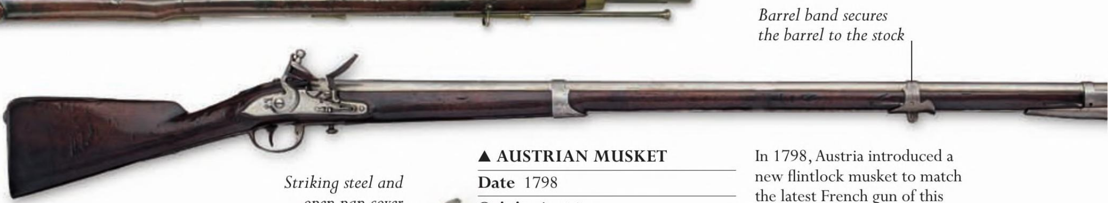
Officers in the French chasseurs, hussars, and dragoons generally carried flintlock pistols similar to this British example. One of a pair, it has a heavy brass butt plate, which could be used as a club in hand-to-hand fighting.



▲ INDIA-PATTERN MUSKET

Date 1797
Origin UK
Weight 4.1kg (9lb)
Barrel 99cm (39in)
Calibre .75in

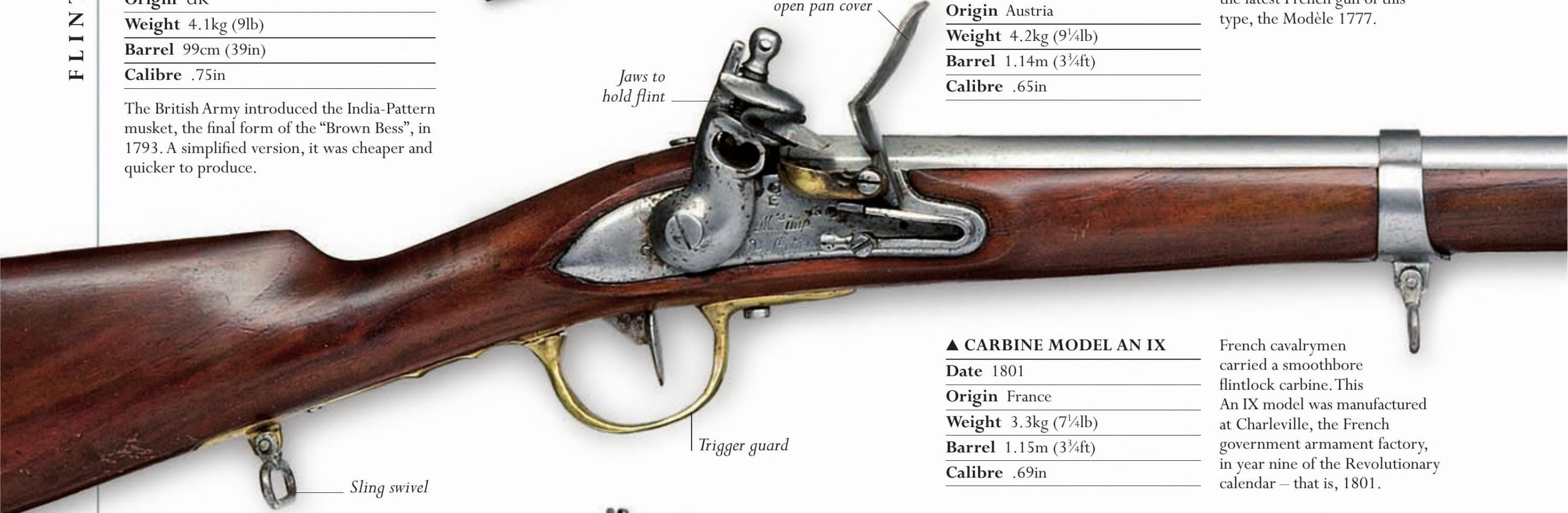
The British Army introduced the India-Pattern musket, the final form of the "Brown Bess", in 1793. A simplified version, it was cheaper and quicker to produce.



▲ AUSTRIAN MUSKET

Date 1798
Origin Austria
Weight 4.2kg (9¼lb)
Barrel 1.14m (3¾ft)
Calibre .65in

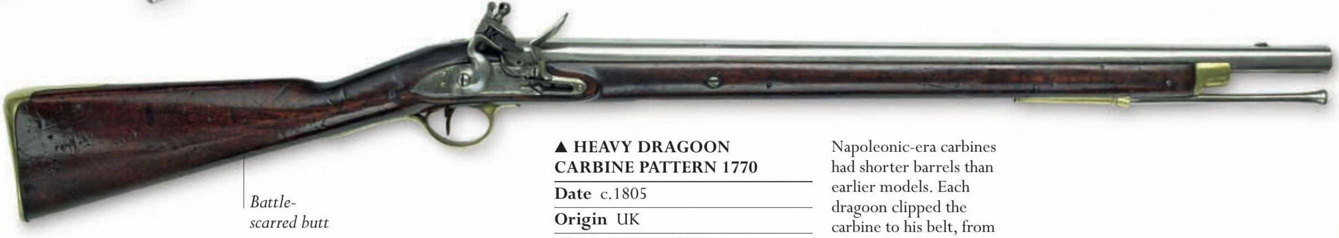
In 1798, Austria introduced a new flintlock musket to match the latest French gun of this type, the Modèle 1777.



▲ CARBINE MODEL AN IX

Date 1801
Origin France
Weight 3.3kg (7¼lb)
Barrel 1.15m (3¾ft)
Calibre .69in

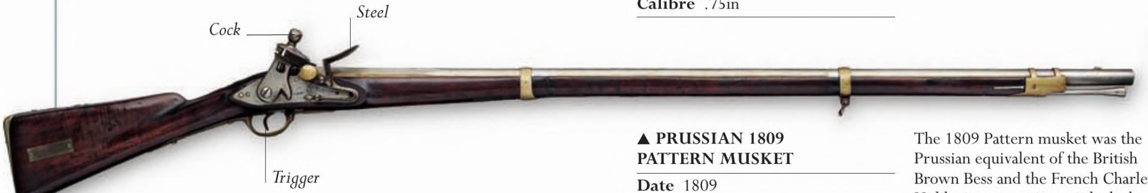
French cavalrymen carried a smoothbore flintlock carbine. This An IX model was manufactured at Charleville, the French government armament factory, in year nine of the Revolutionary calendar – that is, 1801.



▲ HEAVY DRAGOON CARBINE PATTERN 1770

Date c.1805
Origin UK
Weight 3.9kg (8½lb)
Barrel 66cm (26in)
Calibre .75in

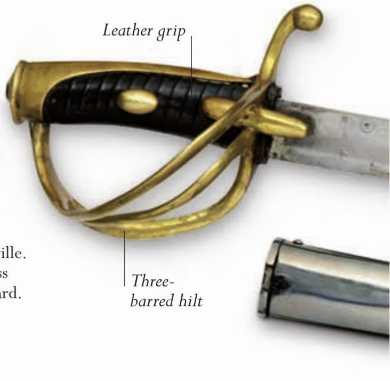
Napoleonic-era carbines had shorter barrels than earlier models. Each dragoon clipped the carbine to his belt, from which it hung next to the thigh.

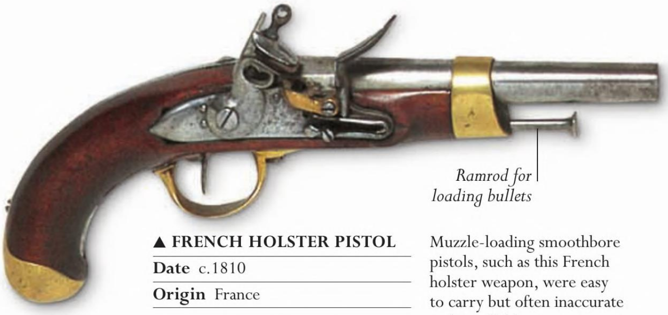


▲ PRUSSIAN 1809 PATTERN MUSKET

Date 1809
Origin Germany
Weight 4kg (8¾lb)
Barrel 1.04m (3½ft)
Calibre .75in

The 1809 Pattern musket was the Prussian equivalent of the British Brown Bess and the French Charleville. Unlike its competitors, it had a brass flash guard around the pan as standard. Most of these flintlocks were later converted to percussion.



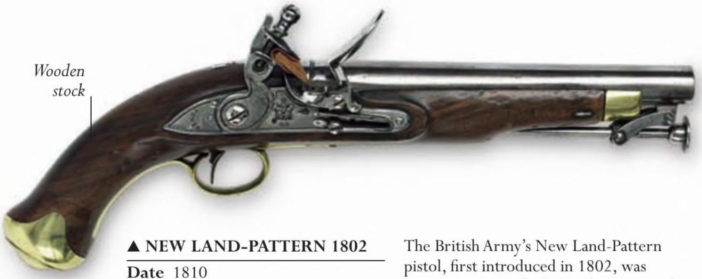

Ramrod for loading bullets

▲ FRENCH HOLSTER PISTOL

Date c.1810

Origin France

Muzzle-loading smoothbore pistols, such as this French holster weapon, were easy to carry but often inaccurate and unreliable.


Wooden stock

▲ NEW LAND-PATTERN 1802

Date 1810

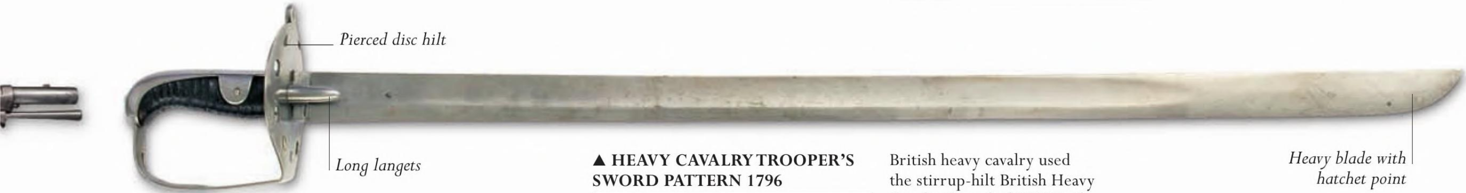
Origin UK

Weight 500g (17½oz)

Barrel 23cm (9in)

Calibre .65in

The British Army's New Land-Pattern pistol, first introduced in 1802, was a competent, sturdy design that remained in service until flintlocks gave way to percussion in the 1840s. A version with a flat butt and lanyard ring was produced for the cavalry.


Pierced disc hilt
Long langets
Heavy blade with hatchet point

▲ HEAVY CAVALRY TROOPER'S SWORD PATTERN 1796

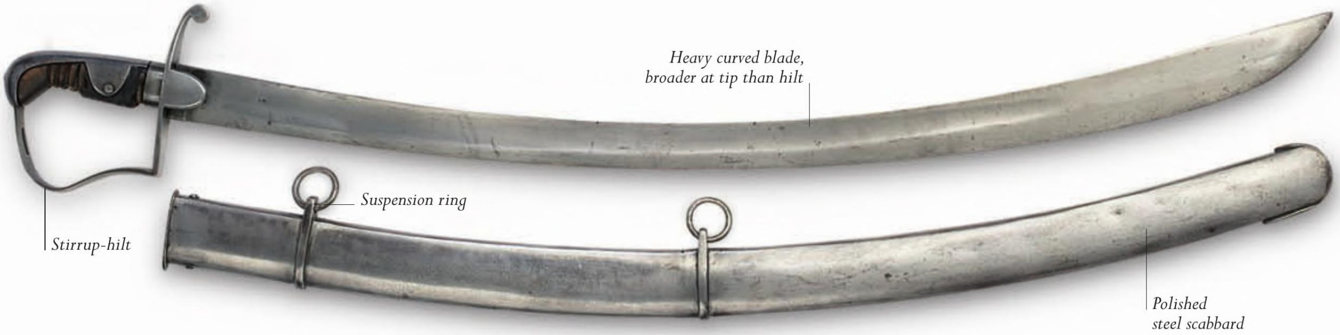
Date 1796

Origin UK

Weight 1.13kg (2½lb)

Length 1.01m (3¼ft)

British heavy cavalry used the stirrup-hilt British Heavy Cavalry Sword of 1796 in the Napoleonic Wars. They criticized it for being unwieldy, but it was a forceful cutting sword.


Heavy curved blade, broader at tip than hilt
Suspension ring
Stirrup-hilt
Polished steel scabbard

▲ LIGHT CAVALRY TROOPER'S SWORD PATTERN 1796

Date c.1800

Origin UK

Weight 1kg (2¼lb)

Length 96.5cm (38in)

This British light cavalry sword had a heavy blade that broadened towards the tip. This added power at the point of impact – a single blow could sever an arm or split a skull.

▼ FRENCH CAVALRY SABRE

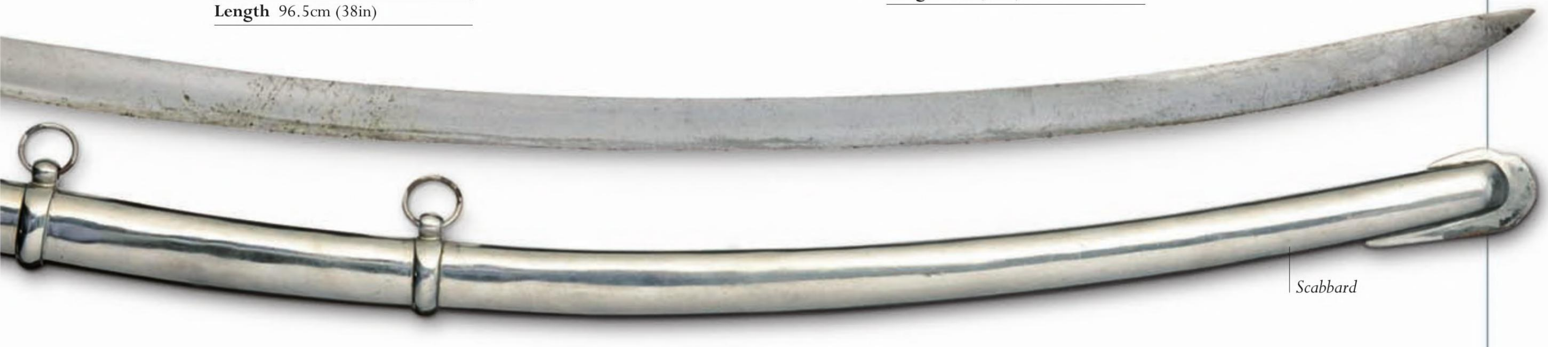
Date 1802

Origin France

Weight 1kg (2¼lb)

Length 1m (3¼ft)

French cavalry sabres had narrower blades than their British counterparts. The iron scabbard was tougher than earlier brass and leather examples.

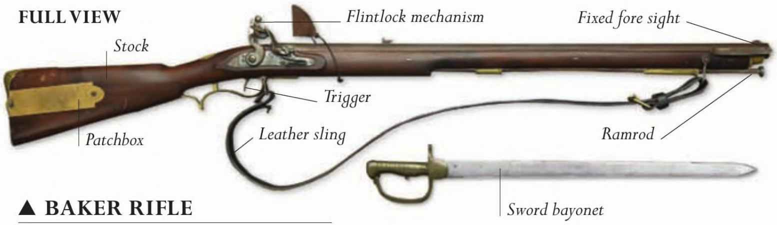


FOREFATHER OF THE MODERN RIFLE

BAKER RIFLE

In February 1800, the Baker rifle won a competition organized by the Army's Board of Ordnance and became the first rifle officially adopted by the British Army. It was similar to weapons in use in Germany, and its novel feature lay in its barrel. With shallow or "slow" rifling – just a quarter-turn in the length of the barrel – it stayed clean and thus usable for longer, a great practical advantage for the rifleman in the field. It was superseded from 1837 by the heavier, muzzle-loading Brunswick rifle.

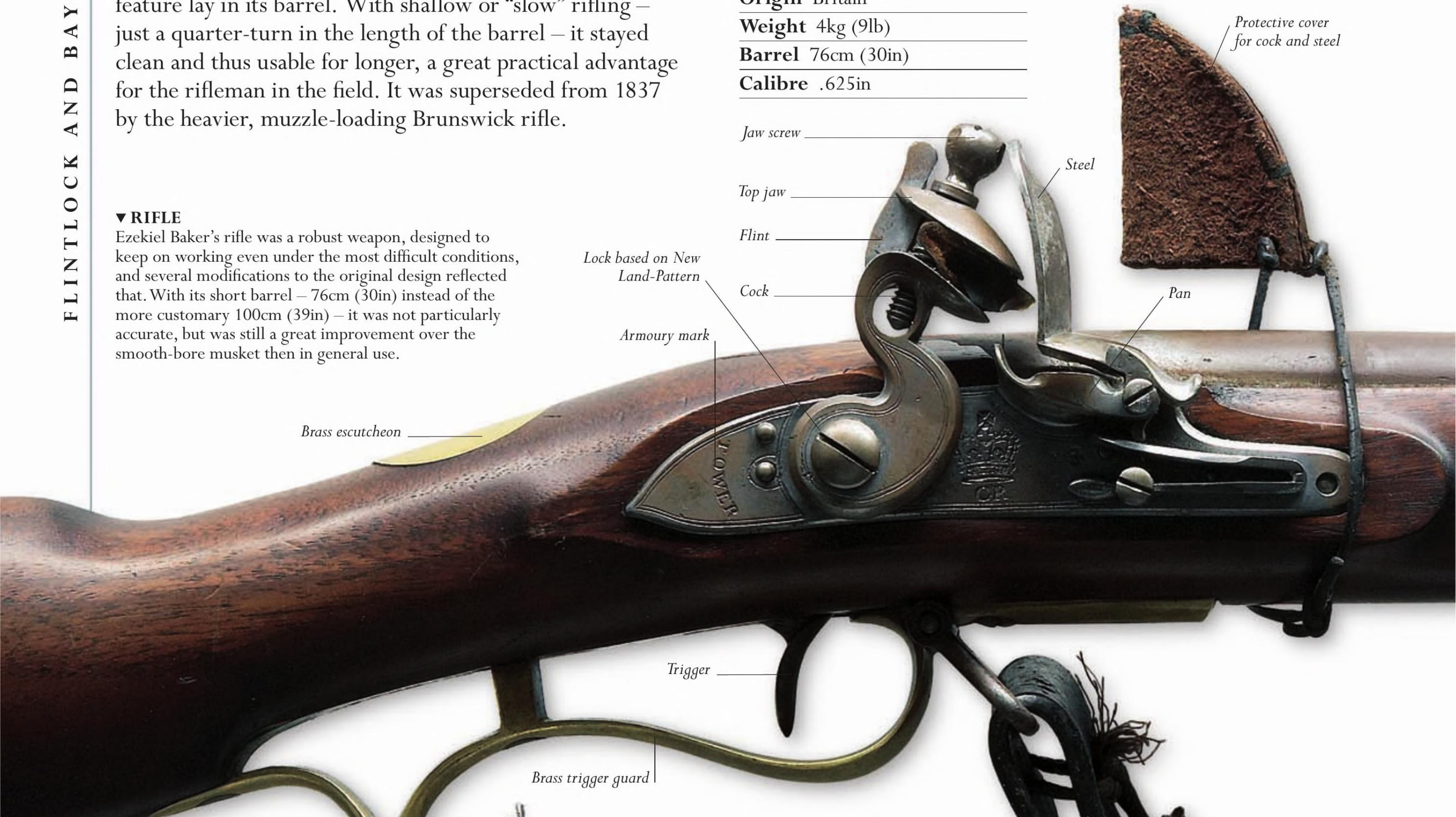
FULL VIEW


Flintlock mechanism
Fixed fore sight
Stock
Trigger
Patchbox
Leather sling
Ramrod
Sword bayonet

▲ BAKER RIFLE

Date	1800
Origin	Britain
Weight	4kg (9lb)
Barrel	76cm (30in)
Calibre	.625in

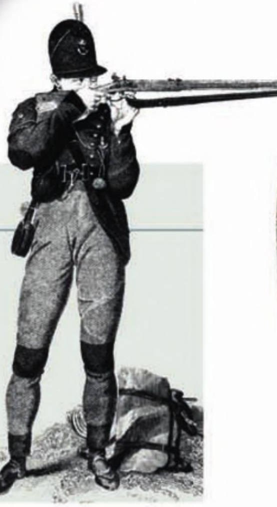
▼ RIFLE
Ezekiel Baker's rifle was a robust weapon, designed to keep on working even under the most difficult conditions, and several modifications to the original design reflected that. With its short barrel – 76cm (30in) instead of the more customary 100cm (39in) – it was not particularly accurate, but was still a great improvement over the smooth-bore musket then in general use.


Protective cover for cock and steel
Jaw screw
Steel
Top jaw
Flint
Lock based on New Land-Pattern
Cock
Pan
Armoury mark
Brass escutcheon
Trigger
Brass trigger guard

IN ACTION

ON THE BATTLEFIELD

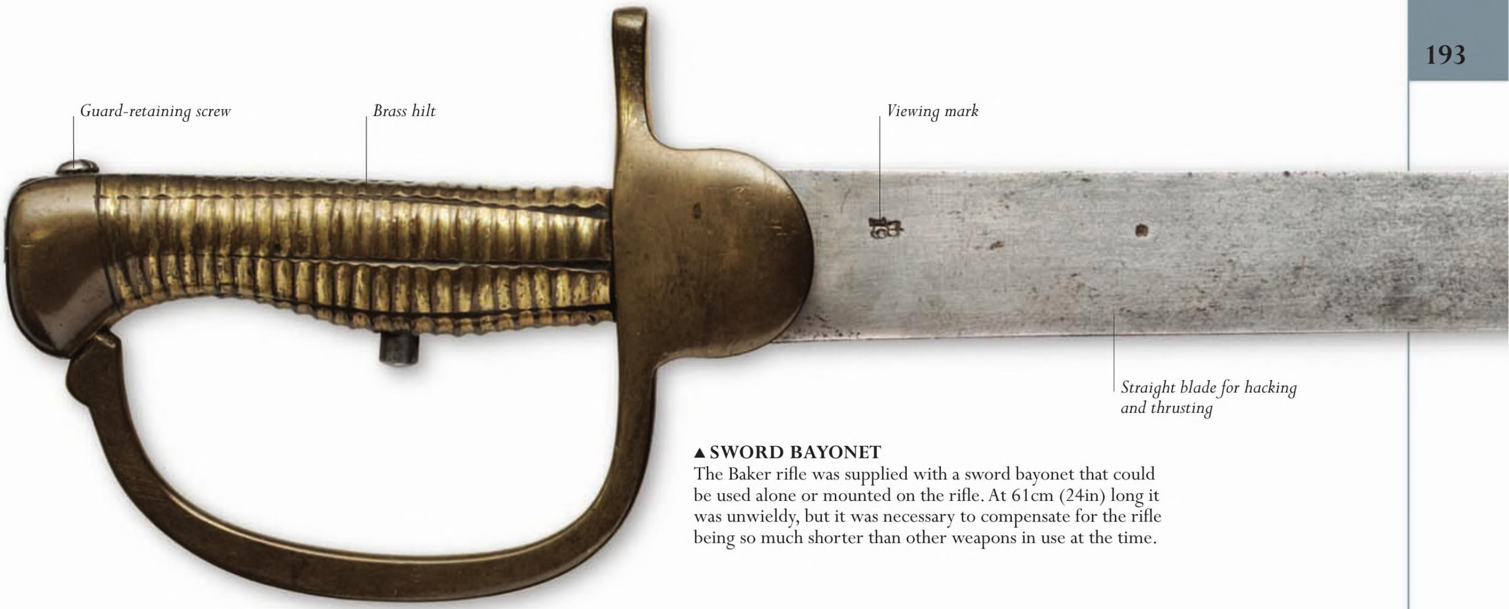
The Baker rifle was used by many British Army regiments, including the 95th (Rifle) Regiment, raised specifically to exploit the Baker, and the Duke of Cumberland's Sharpshooters. It saw early action at Ferrol, in Spain, in 1800, and later, to great effect in the Peninsular War of 1808–14.



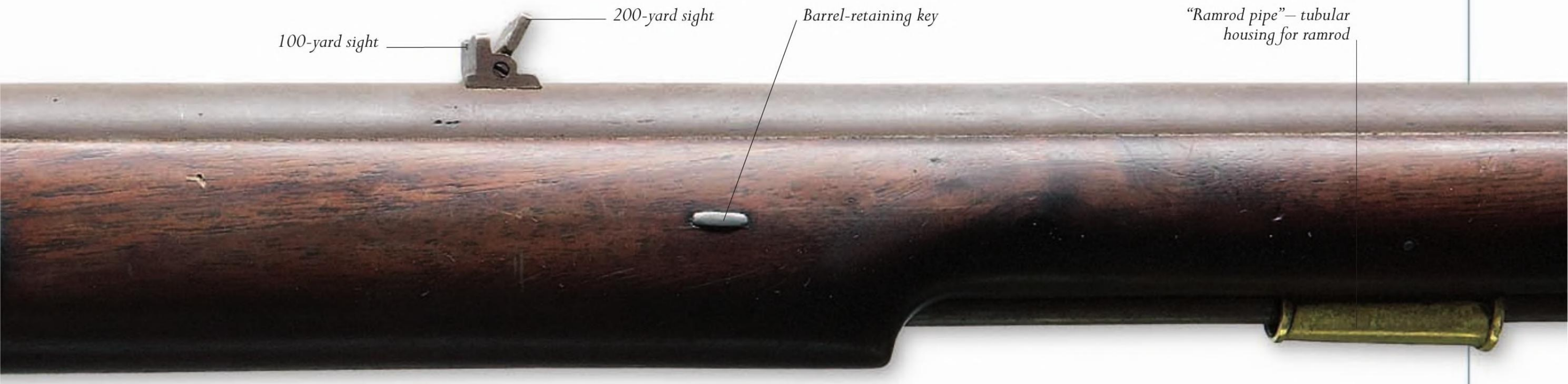
▶ A Sharpshooter steadies his rifle using its sling.

Rolled cowhide head
Beechwood shaft

◀ MALLET
To begin with, small mallets – used to tap the ramrod, to ram down the ball – were issued, but were soon found to be unnecessary. Hand pressure alone was sufficient.


Guard-retaining screw
Brass hilt
Viewing mark
Straight blade for hacking and thrusting

▲ SWORD BAYONET
The Baker rifle was supplied with a sword bayonet that could be used alone or mounted on the rifle. At 61cm (24in) long it was unwieldy, but it was necessary to compensate for the rifle being so much shorter than other weapons in use at the time.


100-yard sight
200-yard sight
Barrel-retaining key
"Ramrod pipe"– tubular housing for ramrod

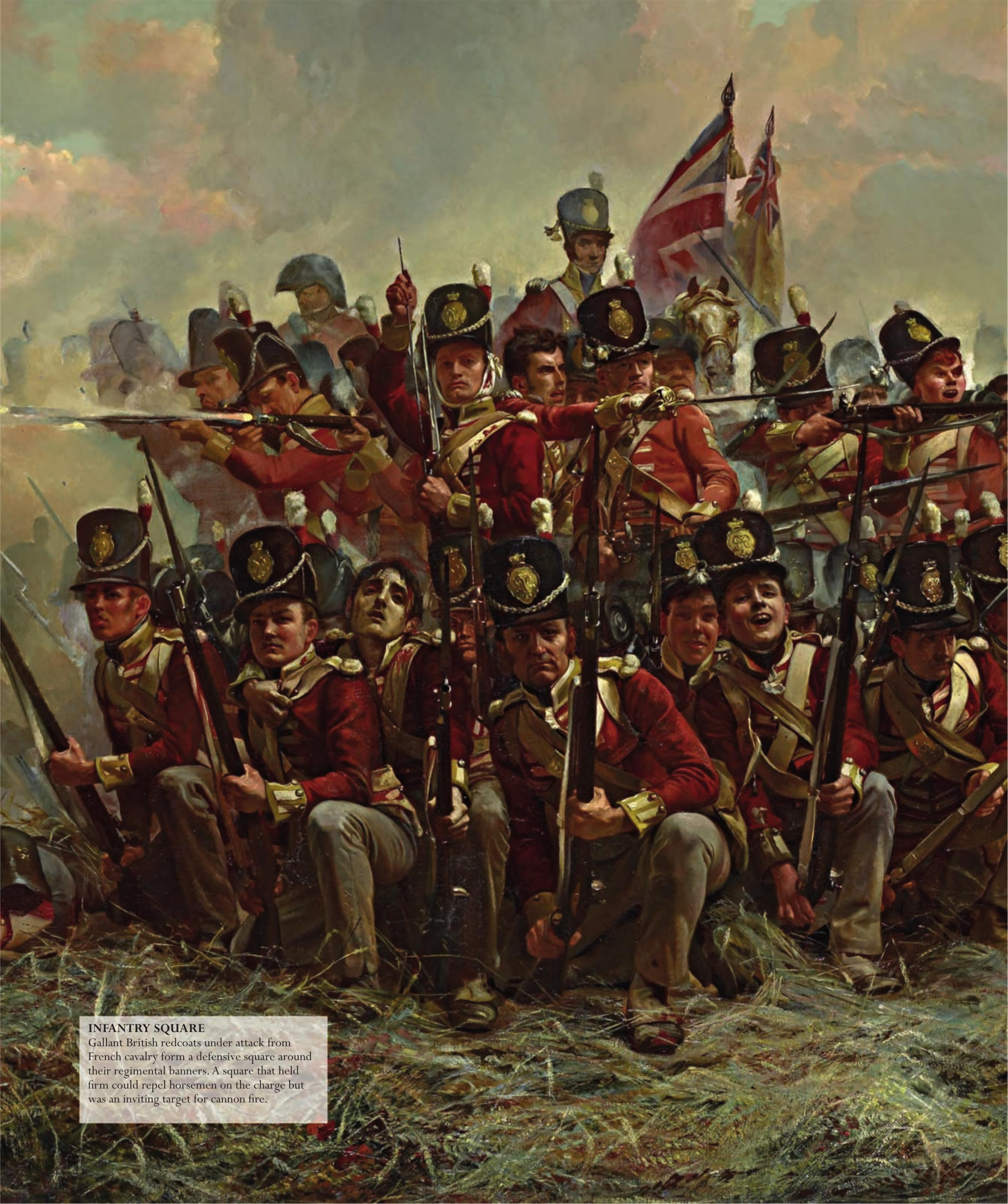
Gunpowder wrapped in paper
Lead ball wrapped in paper

◂ PAPER-WRAPPED CARTRIDGE
This contained a charge of powder and a lead ball. To load a shot, the rifleman tore it open with his teeth, leaving the ball in the paper. He poured a small portion of the charge into the pan and the rest down the muzzle, and rammed the paper down the barrel with the ramrod to form a wad. He then rammed the ball down on top, wrapped in a patch taken from the patchbox.

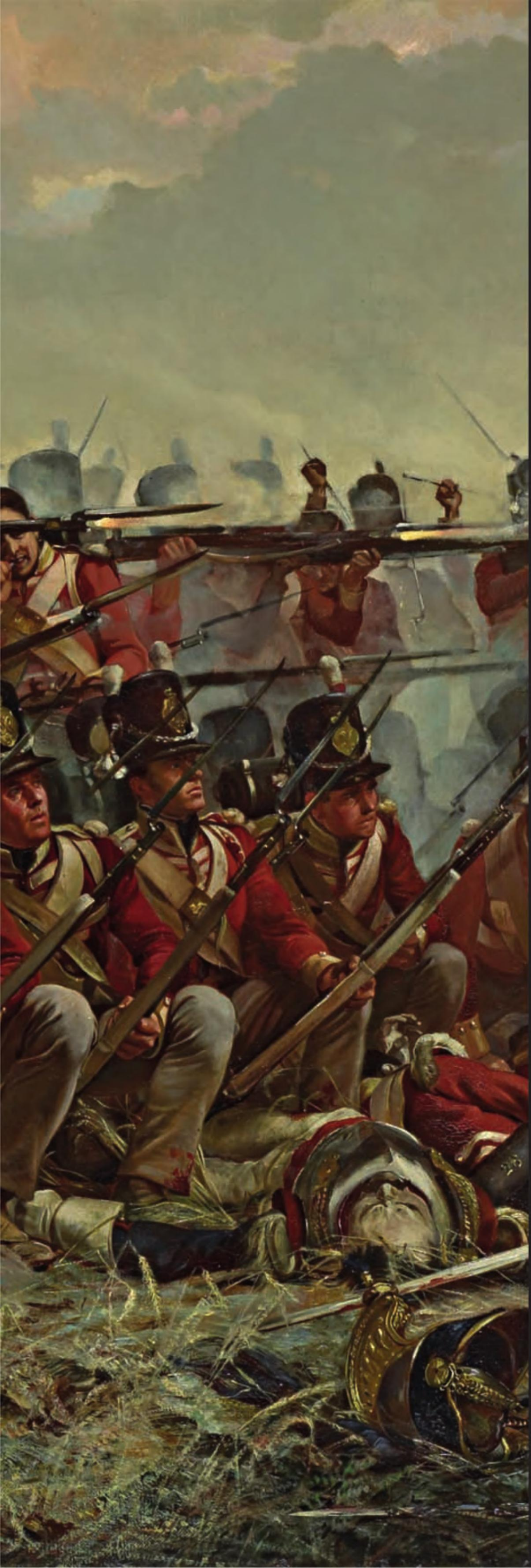
▸ RAMROD
The steel rod was used to ram the charge and projectile into the barrel.

Cup end fitted around the ball

Sling could be used to steady the aim (see box)



INFANTRY SQUARE
Gallant British redcoats under attack from French cavalry form a defensive square around their regimental banners. A square that held firm could repel horsemen on the charge but was an inviting target for cannon fire.



CAVALRY AND THE INFANTRY SQUARE

THE BATTLE OF WATERLOO

Through the 18th and early 19th centuries, European warfare centred around the use of rigidly disciplined infantry armed with smoothbore flintlock muskets and bayonets. This style of fighting reached its climax at Waterloo on 18 June 1815, when superior French artillery and cavalry failed to crack the Duke of Wellington's steady foot soldiers.

Waterloo was the last battle of the Napoleonic Wars. On 18 June, Wellington drew up his forces in a defensive position on a ridge, intending to hold off Napoleon's 70,000-strong army until Britain's allies, the Prussians, could reach the battlefield and tip the balance decisively against the French.

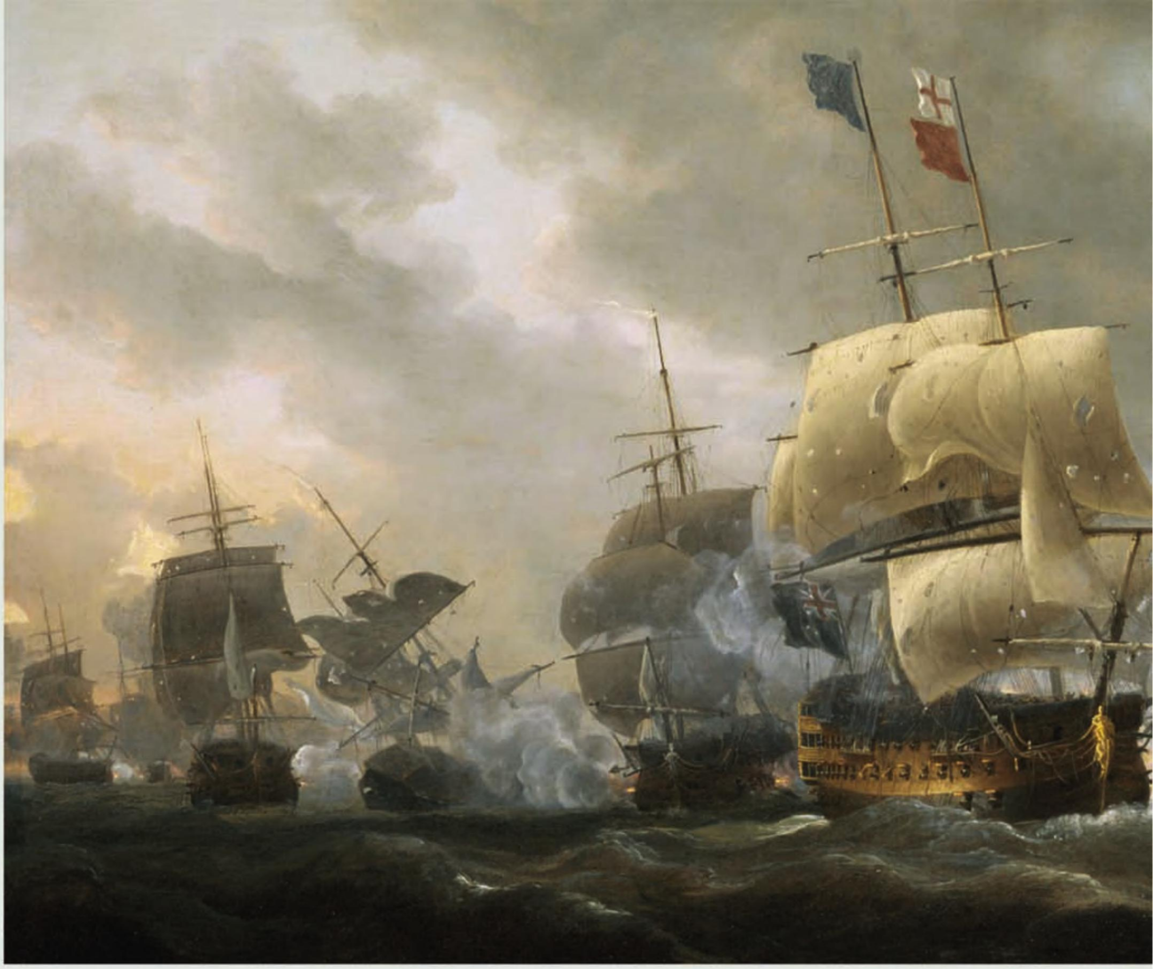
Wellington fortified a chateau and farmhouse in the front of his position as strongpoints to delay the French attack, but he knew his eventual success or failure would depend on the firmness of his infantry fighting in an open field. The infantry were strictly trained to march in columns, deploy in lines, and fire in volleys. The great majority were equipped with inaccurate but reliable flintlock muskets. Additionally, British riflemen, armed with the effective Baker rifle, could fight as skirmishers in loose formation or in line.

Napoleon opened the battle with a bombardment by the heavy cannon parked at the rear of his position. While fighting raged around the chateau and farm, the French launched a corps-strength infantry attack on the centre of the British line. At first skirmishing troops, the *voltigeurs*, swarmed forward to snipe at Wellington's men, who were drawn up in formation two lines deep. The main body of French troops then advanced in large close-packed columns with bayonets fixed. Each British soldier could fire three rounds a minute, and with two lines firing alternate volleys, the infantry poured six volleys a minute into the dense French ranks. As field artillery joined in, sweeping the columns with canister, grapeshot, and shrapnel, the French were halted and driven back, sustaining heavy casualties.

HOLDING THE SQUARE

In the afternoon, around 4:00pm, Wellington's infantry were exposed to repeated attacks by French cavalry. Napoleon's horsemen ranged from heavily armoured cuirassiers to lighter dragoons, chasseurs and hussars, and a body of Polish lancers. The standard infantry response to a cavalry charge was to form squares. The square's "walls" consisted of soldiers three or four lines deep. The bayonets of the front line, bristling outward, held the enemy horses at bay on all four sides while the men further inside the square fired at the cavalry. The lancers' weapons were long enough to reach into the square, but the real threat lay in artillery. In the late afternoon, after taking the fortified farm, the French moved their cannon forward to blast at the infantry squares. Once savaged by shot or shell, a square could be penetrated by cavalry, who cut down the foot soldiers with their swords.

Wellington later commented that he was "never as near being beat" as at Waterloo. But ultimately his line held both against the cavalry charges and a final attack by the infantry of Napoleon's elite Imperial Guard. As the Prussians, led by Count von Blücher, arrived on the French flank, Wellington ordered a general advance. The French were driven from the field and Napoleon's remarkable military career was finally brought to an end.



KEY DEVELOPMENT

NAVAL BATTLES IN THE AGE OF SAIL

By the early 1800s, naval power had become a crucial concern for European powers ruling overseas empires. Substantial resources were devoted to sailing ship fleets, heavily armed with muzzle-loading, smoothbore cannon.

The basic tactics and technology for sailing-ship warfare were established in the 17th century, and did not fundamentally alter until the end of the age of sail in the mid-19th century. Cannon were mounted in broadside (along the ship's sides) and fleets fought in line, side-on to the enemy. Shots were aimed either at the hull, to cause maximum damage to the ship and crew, or at the masts and rigging to disable the vessel. However, wooden ships were almost impossible to sink with solid shot, and explosive shells were considered too dangerous for use at sea. As a result, engagements ended only when a ship was taken by boarding, or when a captain surrendered to avoid further carnage.

THE AGE OF THE WARSHIP

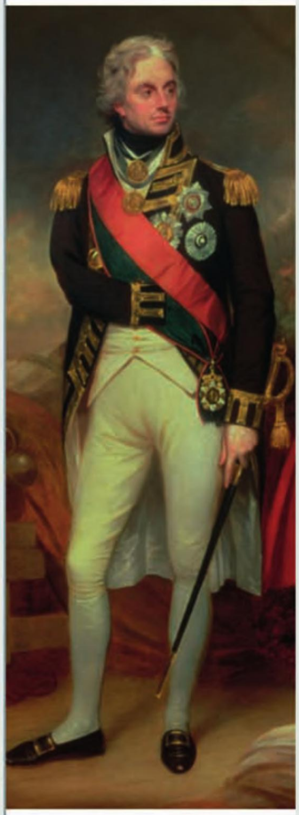
By this period, navies consisted entirely of purpose-built warships. The role of raiding an enemy's merchant ships, once filled by privateers, was now allotted to naval frigates. The French, who tended to lead in ship design, introduced the classic frigate in 1740, a fast-sailing vessel with a single gundeck mounting at least 28 cannon. Ships of the line were either 74- or 80-gun vessels, with two or three decks and 100 cannon or more. To put this in

KEY **FIGURE**

HORATIO NELSON

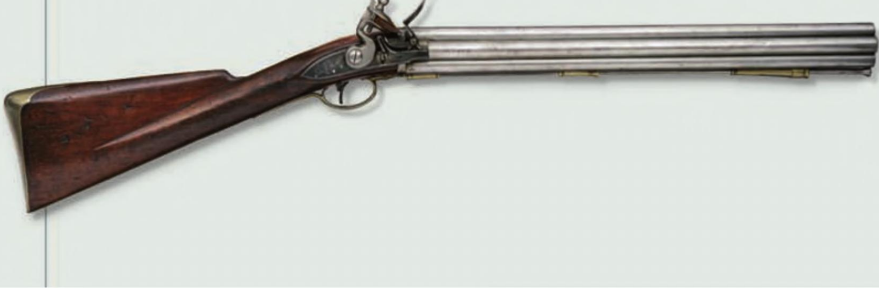
1758–1805

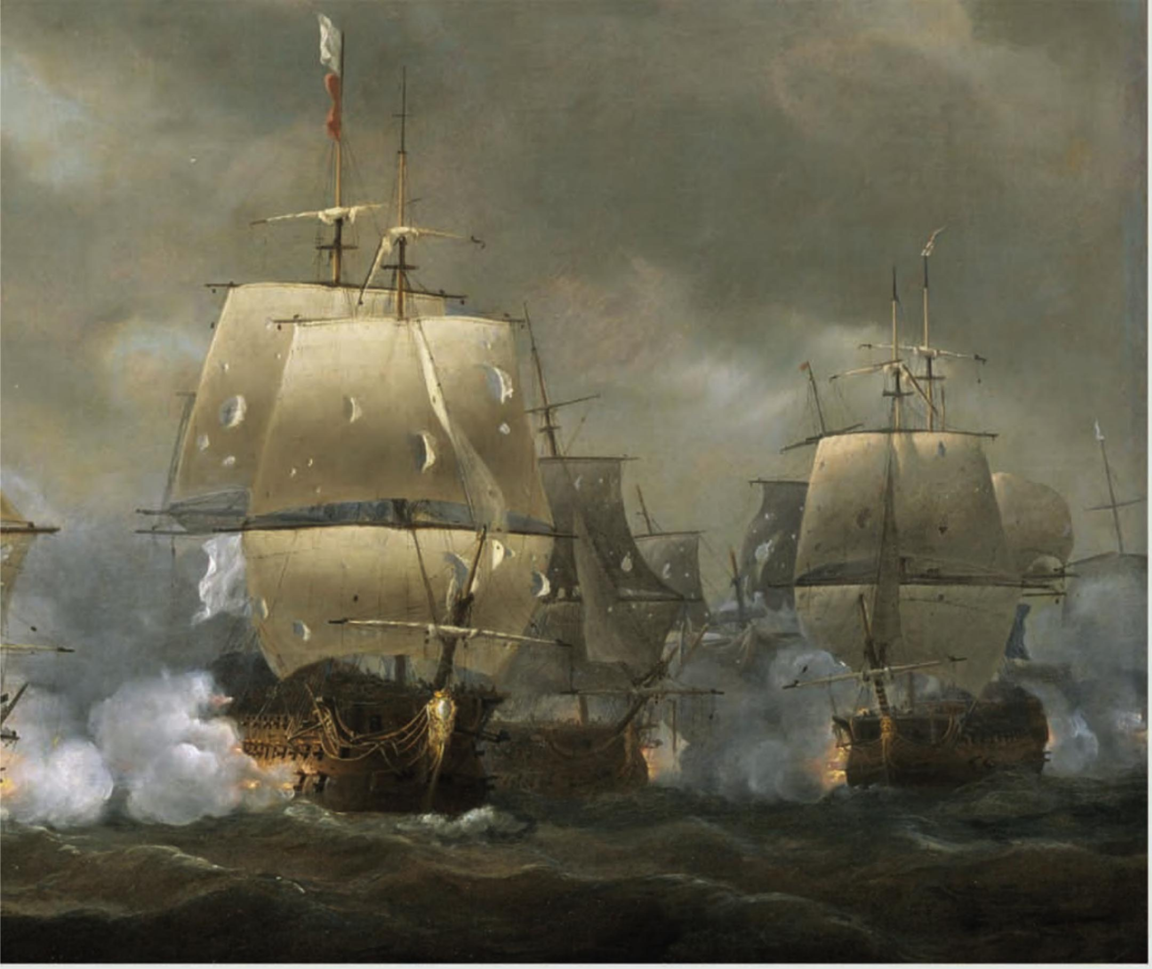
Nelson was a fearless and often insubordinate British admiral who was brought to prominence by a bold manoeuvre at Cape St Vincent, in 1797. His victories at the Nile (1798), Copenhagen (1801), and Trafalgar (1805) made him a national hero.

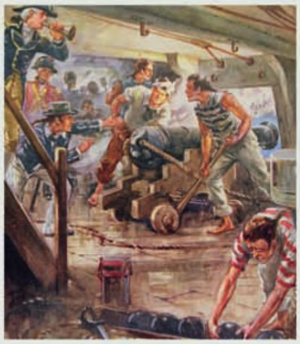


▲ Nelson lost an arm, and the sight in one eye, while leading from the front. He died on board HMS *Victory*.

▼ NOCK VOLLEY GUN
Volley guns were used in ship-to-ship fighting during the Napoleonic Wars. This model proved to be unwieldy due to the powerful recoil caused by seven barrels firing simultaneously.







▲ A GUN CREW AT BATTLE STATIONS
To fire a naval cannon, the crew rammed a gunpowder cartridge and cannonball down the barrel, "ran" the gun out so the barrel protruded from the gun port, and ignited the charge.

◀ THE BATTLE OF QUIBERON BAY
In November, 1759, British Admiral Edward Hawke pursued a French invasion fleet of 21 ships into Quiberon Bay, off the coast of France. The 24 British ships of the line shattered the French navy, effectively ending its role in the Seven Years' War.

perspective, in 1805 an entire corps of Napoleon's army had only 40 cannon. Over time there were significant but limited technological improvements. A flintlock mechanism was first applied to naval cannon in 1745, but the slow-burning linstock (a forked staff that held a match) was still used in the early 19th century to fire cannon aboard many warships. The carronade, a light but powerful short-range gun introduced in the 1770s, was a notable addition to the firepower of naval fleets.

TECHNOLOGY AND TACTICS

More influential were general improvements in sailing technology, from accurate navigation to progress in nutrition and medical care. The practice of sheathing underwater wooden hulls with copper, widely adopted from the 1770s, made ships faster and able to stay at sea for longer periods without docking for careening (cleaning and repair). The chief developments, however, were tactical rather than technological. Britain's Royal Navy – by the early 17th century the world's leading naval power – traditionally had a commitment to attack and, with superior gunnery, expected to defeat its enemies if it could bring them to battle. In the Seven Years' War (1756–63), the boldest British admirals practised aggressive tactics known as the "general chase" – each ship racing to engage a fleeing enemy without waiting to take its allotted place in a formal line of battle. From the 1780s onwards, the British developed the tactic of cutting through the enemy line, instead of sailing parallel to it, so that part of the opposing fleet could be surrounded and destroyed. This strategy was taken to its extreme by Admiral Horatio Nelson, who sought to force the enemy into a "pell-mell" battle – a savage and chaotic close-quarters mêlée in which British gunnery and fighting spirit would carry the day. Nelson won decisive victories with these risky tactics and helped secure British naval dominance for another century.

> "No captain **can do very wrong** if he places his ship alongside that of **an enemy**"
>
> **ADMIRAL NELSON**, BEFORE THE BATTLE OF TRAFALGAR, OCTOBER 1805

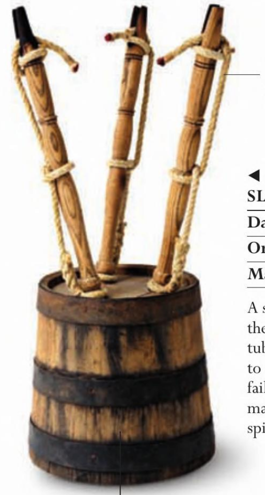
KEY **EVENTS**

1740–1805

- **1740** The French warship *Médée* is the first of a new type of frigate that will play a large part in naval warfare into the 19th century.
- **1761** On an experimental basis, the British Royal Navy coppers the hull of the 32-gun frigate HMS *Alarm*.
- **1763** The French navy adopts a system of signal flags that includes a number code. These greatly improve the visual communication of messages at sea.
- **1782** At Saintes, in the Caribbean, a British fleet under Admiral George Rodney breaks through the French battle line, initiating a new phase in British naval tactics.
- **1794** The US Navy is founded by an act of Congress, leading to the construction and manning of six powerful 44-gun or 38-gun frigates.
- **1805** Victory over a French and Spanish fleet at Trafalgar establishes a durable British command of the sea; Admiral Nelson of the British fleet is killed in the battle.

NAVAL GUNS AND KIT

Naval cannon first appeared in the mid-14th century in the form of wrought-iron breech-loaders. Cast-bronze muzzle-loaders were developed in the 16th century, and by the 18th century all European navies were widely using cast-iron muzzle-loaders, such as the British versions shown here. To charge muzzle-loaders of this type, a fabric powder cartridge was loaded down the muzzle and into the chamber, followed by a rope wad to hold it in place, the shot, and a second rope wad. The charge was pricked by inserting a wire pricker into the vent, then the gunpowder was poured in. Either a gunlock or a slow match held at the vent hole was used to fire the gun.


Slow match burned at a rate of 30cm (12in) every three hours
Wooden keg

◀ MATCH TUB AND SLOW MATCHES

Date	c.1800
Origin	UK
Material	Wood, hemp

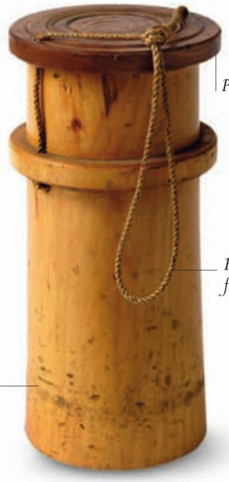
A slow match was lit at the start of the battle and placed in the match tub. It kept burning and was used to ignite the charge if the gunlock failed. Made from hemp, the slow match was boiled in a solution of spirits of wine and saltpetre.

Canvas sheet

▲ CARTRIDGE

Date	c.1800
Origin	UK
Material	Canvas

Paper, canvas, or parchment were sewn into different size cylinders as gunpowder containers. A precise amount of gunpowder was used depending on the gun and the type of charge.


Poplar lid
Rope strap for carrying
Elm cylinder

▲ CARTRIDGE CASE

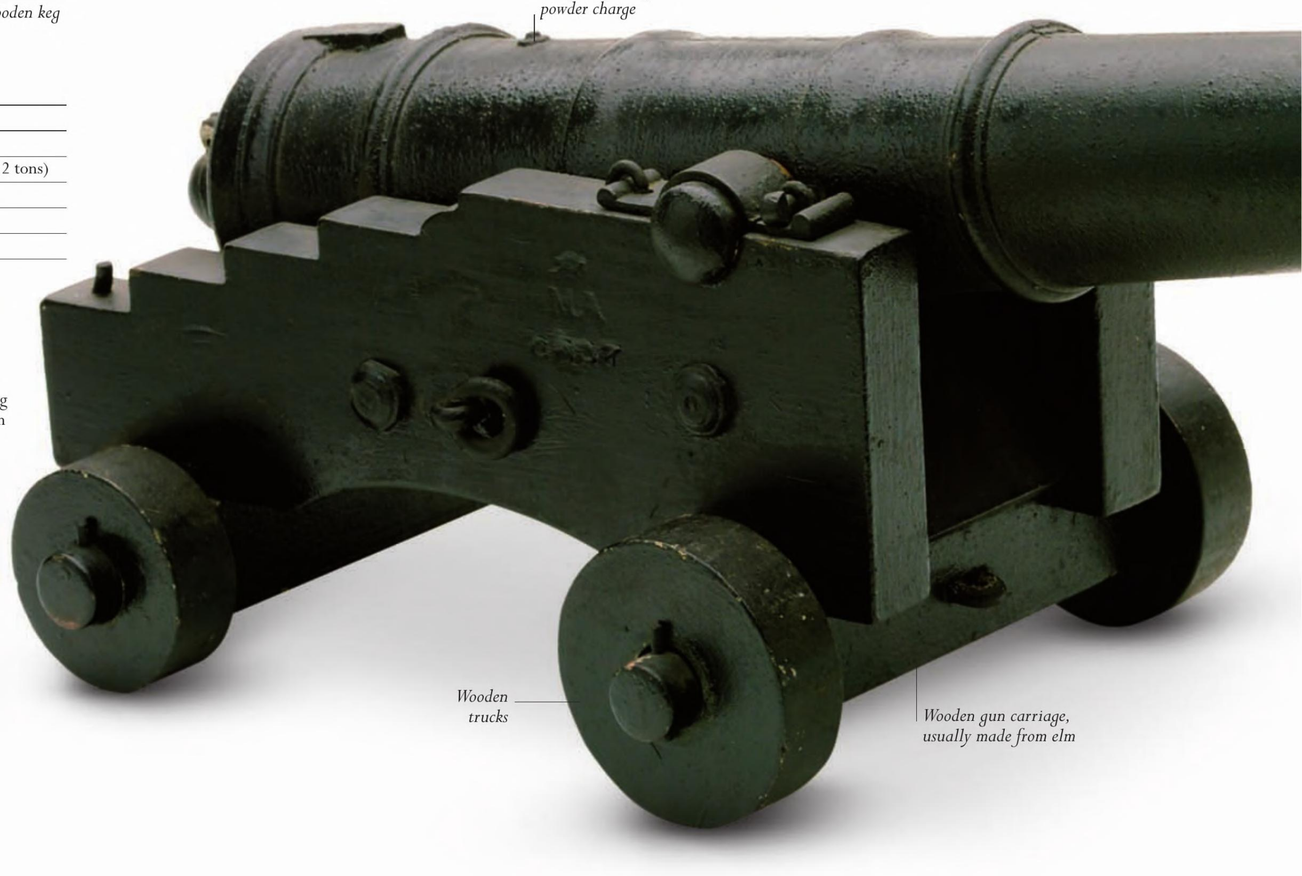
Date	c.1800
Origin	UK
Material	Wood

To prevent accidental explosions, cartridges had to be carried with great care from the magazines to the guns. A lightweight wooden cylinder was used to protect and carry each cartridge.

◀ ROPE WAD

Date	c.1800
Origin	UK
Material	Rope

Oddments of rope and rope fibre (oakum, or "junk") were used to make wads, which were rammed down the barrel of the gun to hold the charge and shot in place.


Vent for igniting powder charge
Wooden trucks
Wooden gun carriage, usually made from elm

▶ CAST-IRON 24-POUNDER

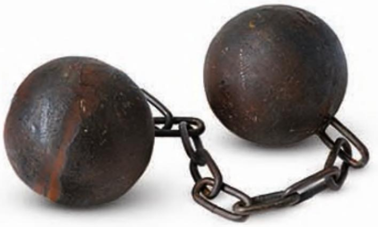
Date	1785–1822
Origin	UK
Weight	2.9 tonnes (3.2 tons)
Length	2.9m (9½ft)
Calibre	5.8in
Shot	11kg (24lb)

Naval guns were mounted on wheeled wooden carriages, allowing them to run backwards under recoil. This motion was controlled by restraining ropes around the breech or carriage.

◀ ROUND SHOT

Date c.1800
Origin UK
Material Iron

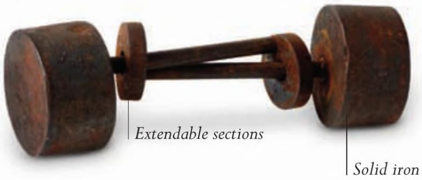
Naval ammunition generally had three purposes – to punch holes in the side of an enemy ship, to bring down masts and sails, or to kill the enemy. An accurate and long-range type of munition, round shot was used for its penetrating effect against a ship's hull.



◀ CHAIN SHOT

Date c.1800
Origin UK
Material Iron

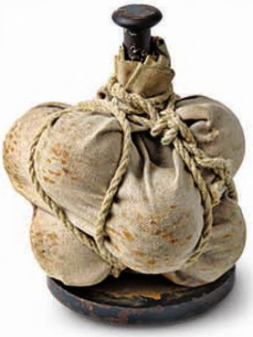
The chain shot – two or more cannonballs linked by a chain – could scythe down enemy crew on an exposed deck. Like other non-round shot, the range and accuracy of chain shot was poor.


Extendable sections
Solid iron

◀ BAR SHOT

Date c.1800
Origin UK
Material Iron

The bar shot was made by linking two or more shot pieces by a fixed bar or extendable bar sections. It was designed to hack away at lines and rigging as it flew over the top of the ship's deck.



◀ GRAPESHOT

Date c.1800
Origin UK
Material Canvas, iron

Grapeshot consisted of balls of metal housed within a tin or a canvas bag. The container shattered when a gun was fired, producing a shotgun-like effect against an enemy crew.

▼ RAMMER

Date c.1800
Origin UK
Material Ash

The rammer was used to push the cartridge, wads, and shot down the full length of the bore and pack it into the firing chamber of the gun.

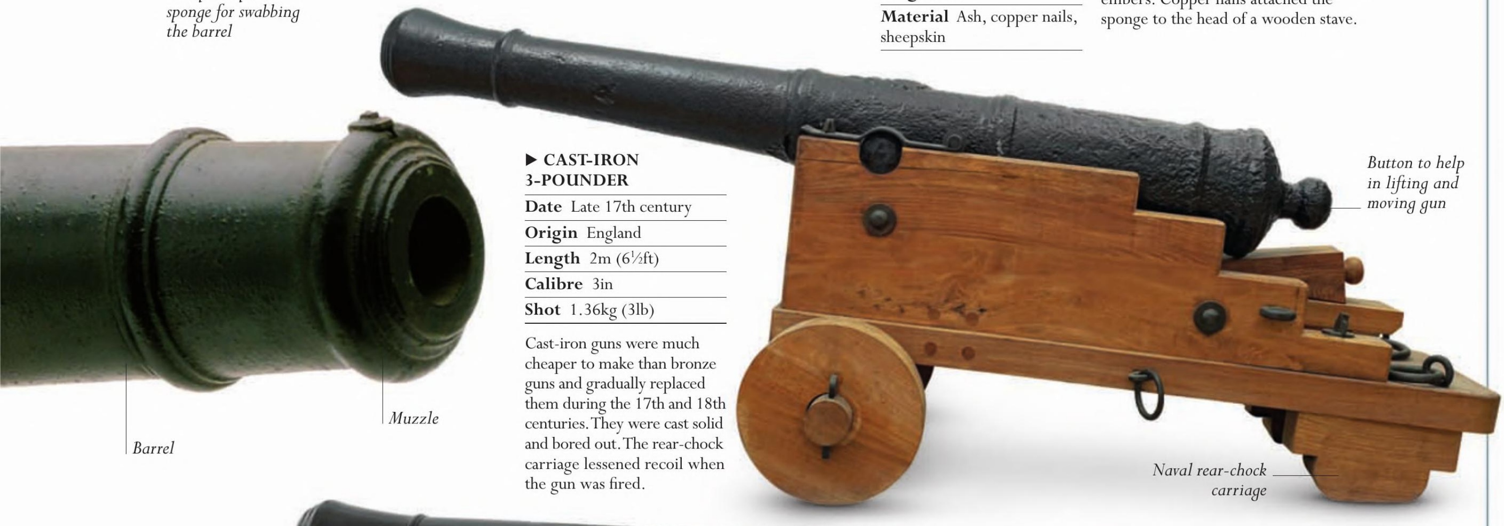
Concave ramming head

Wooden stave
Damp sheepskin sponge for swabbing the barrel

▲ SPONGE

Date c.1800
Origin UK
Material Ash, copper nails, sheepskin

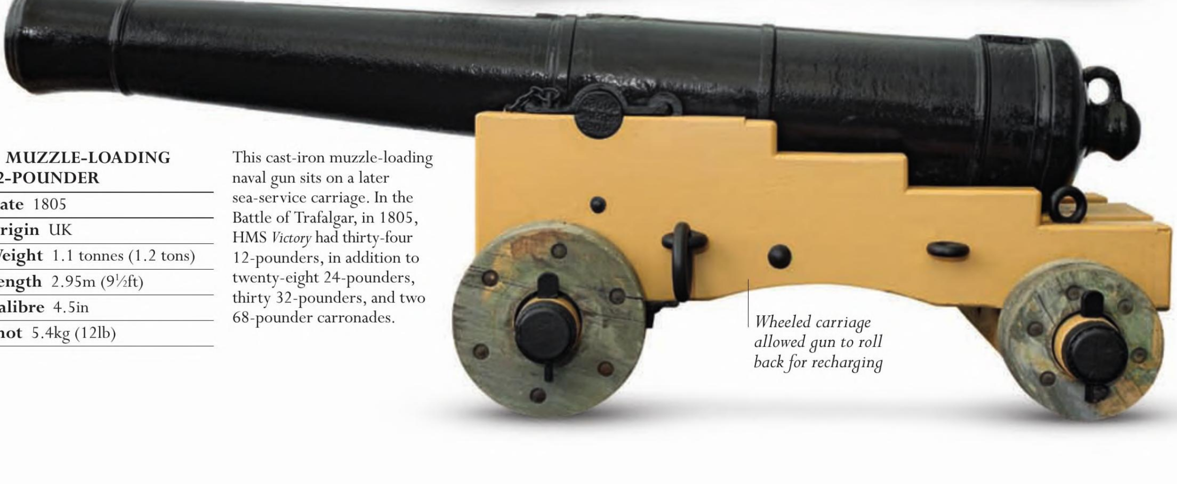
A damp sheepskin sponge was pushed down the barrel after every shot had been fired to extinguish residual burning embers. Copper nails attached the sponge to the head of a wooden stave.


Barrel
Muzzle
Button to help in lifting and moving gun
Naval rear-chock carriage

▶ CAST-IRON 3-POUNDER

Date Late 17th century
Origin England
Length 2m (6½ft)
Calibre 3in
Shot 1.36kg (3lb)

Cast-iron guns were much cheaper to make than bronze guns and gradually replaced them during the 17th and 18th centuries. They were cast solid and bored out. The rear-chock carriage lessened recoil when the gun was fired.


Wheeled carriage allowed gun to roll back for recharging

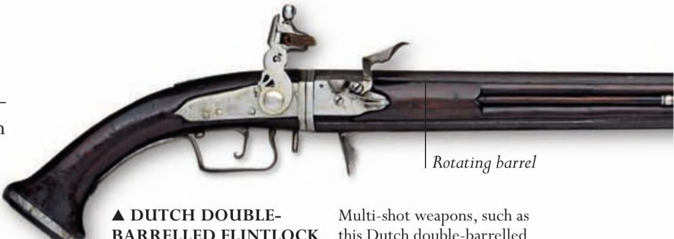
▶ MUZZLE-LOADING 12-POUNDER

Date 1805
Origin UK
Weight 1.1 tonnes (1.2 tons)
Length 2.95m (9½ft)
Calibre 4.5in
Shot 5.4kg (12lb)

This cast-iron muzzle-loading naval gun sits on a later sea-service carriage. In the Battle of Trafalgar, in 1805, HMS *Victory* had thirty-four 12-pounders, in addition to twenty-eight 24-pounders, thirty 32-pounders, and two 68-pounder carronades.

CARRONADES AND OTHER NAVAL GUNS

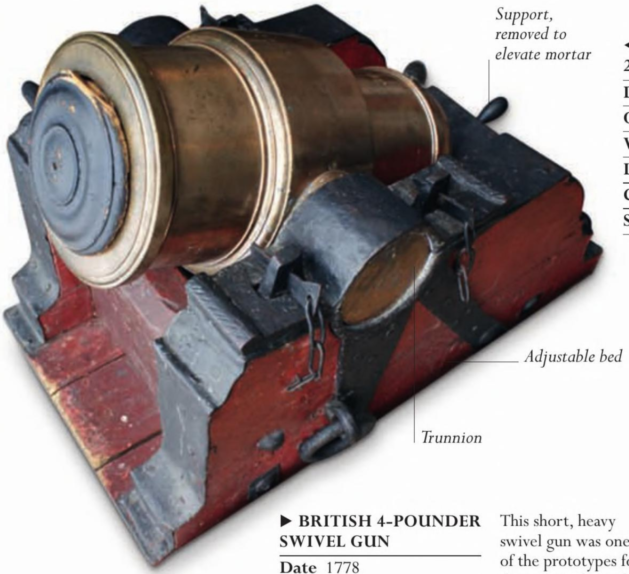
Carronades – a type of smoothbore cast-iron cannon – were an important addition to naval firepower in the late 18th and early 19th century, supplementing light weapons such as multi-shot guns, swivel guns, rockets, and mortars. Quickly adopted by the British, US, Russian, and French navies, carronades – so-called because they were manufactured by the Carron Ironworks in Falkirk, Scotland – were powerful, short-barrelled guns that were relatively lightweight and could be operated by a small crew, but were devastating in close-range engagements. Moreover, while heavy guns such as 32-pounders had to be carried near the waterline so as not to destabilize a ship, carronades were light enough to be mounted on the upper deck.



▲ DUTCH DOUBLE-BARRELLED FLINTLOCK

Date	17th century
Origin	Netherlands
Weight	1.2kg (2½lb)
Barrel	50.3cm (19¾in)
Calibre	36-bore

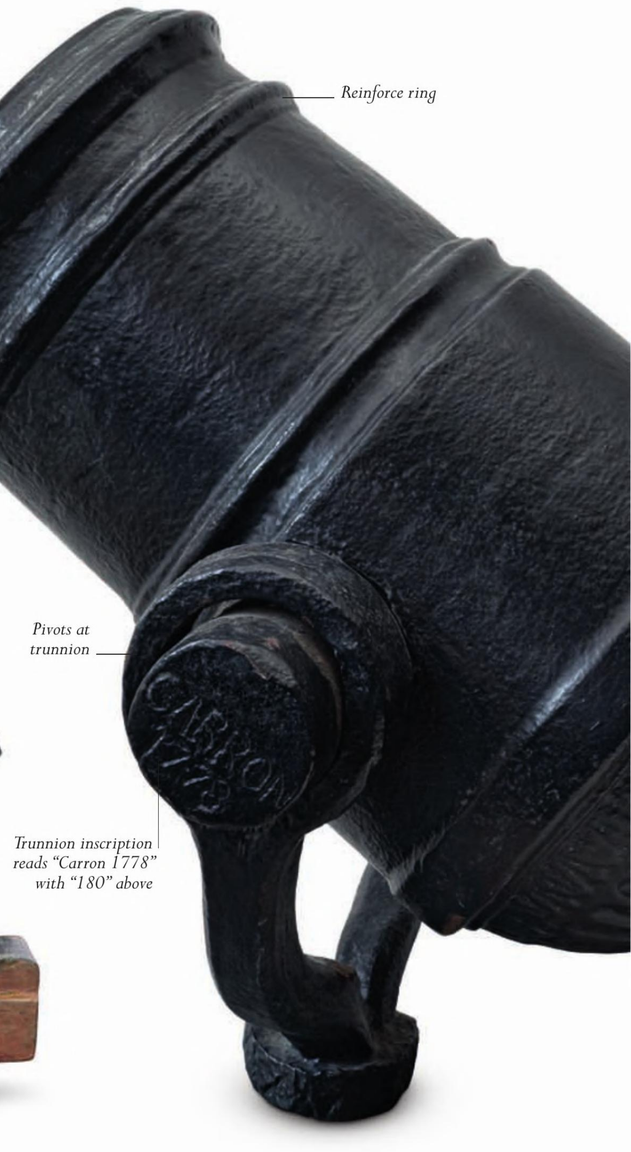
Multi-shot weapons, such as this Dutch double-barrelled flintlock, were used for boarding actions, due to the difficulty of reloading single-shot weapons at close quarters or on an often-pitching deck.



◀ SWEDISH 20-POUNDER MORTAR

Date	1735
Origin	Sweden
Weight	4.1 tonnes (4.5 tons)
Length	1.5m (5ft)
Calibre	13in
Shot	9kg (20lb)

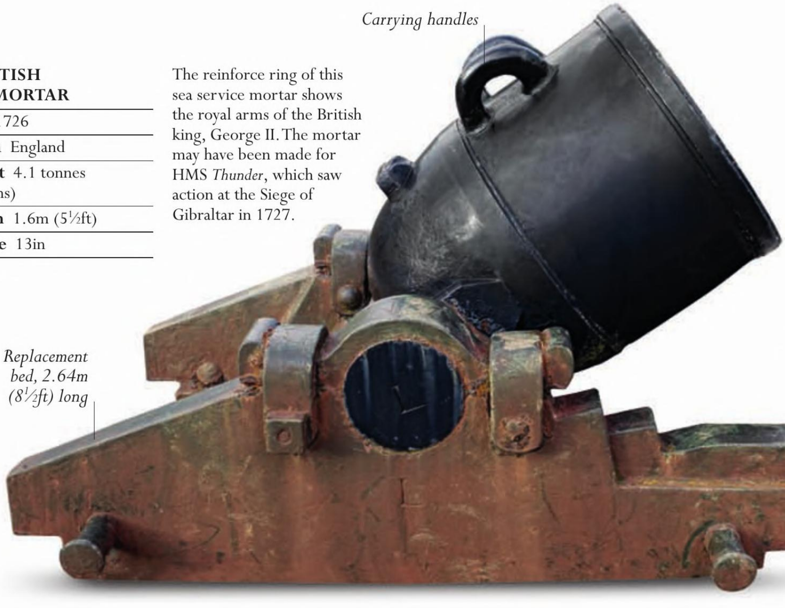
The Swedish navy of the mid-18th century equipped smaller vessels (bomb ketches) with trunnioned mortars, which were adjustable to fire at an elevated angle for improved range. This bronze mortar was mounted towards the bow and generally used to bombard fortifications on land.



▶ BRITISH 4-POUNDER SWIVEL GUN

Date	1778
Origin	Scotland
Length	31.8cm (12½in)
Calibre	8.4cm
Shell	1.8kg (4lb)

This short, heavy swivel gun was one of the prototypes for the carronade made by the Carron Ironworks. Its trunnions are fitted with pivots and the cascabel connected to a long, curved handle for moving the gun.

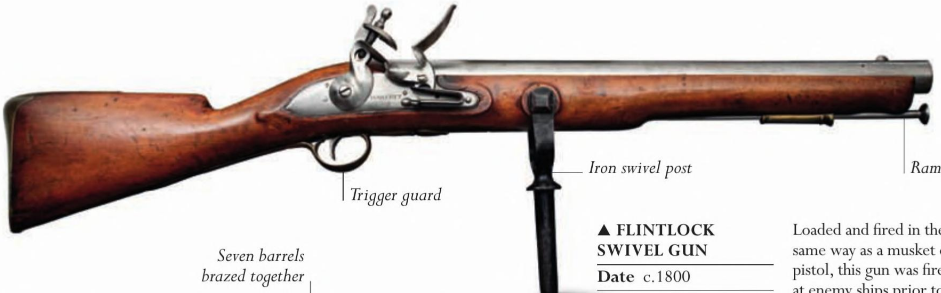


▶ BRITISH 13IN MORTAR

Date	1726
Origin	England
Weight	4.1 tonnes (4.5 tons)
Length	1.6m (5½ft)
Calibre	13in

The reinforce ring of this sea service mortar shows the royal arms of the British king, George II. The mortar may have been made for HMS *Thunder*, which saw action at the Siege of Gibraltar in 1727.

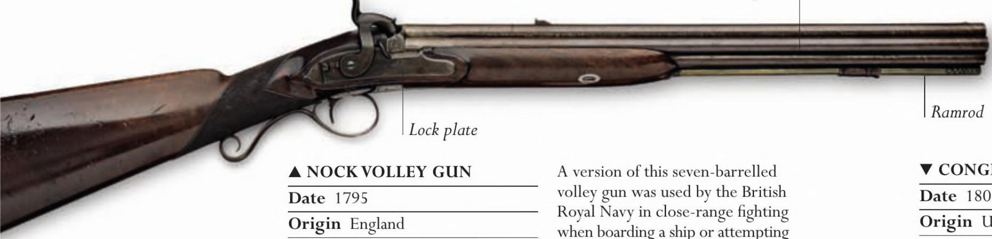
Side-mounted ramrod


Trigger guard
Iron swivel post
Ramrod

▲ FLINTLOCK SWIVEL GUN

Date	c.1800
Origin	UK
Weight	6.8kg (15lb)
Barrel	61cm (24in)
Calibre	28mm

Loaded and fired in the same way as a musket or pistol, this gun was fired at enemy ships prior to a boarding attempt. Because it could be swivelled, the gun – moving from side to side – had a wide arc of fire.


Striking steel
Seven barrels brazed together
Lock plate
Ramrod

▲ NOCK VOLLEY GUN

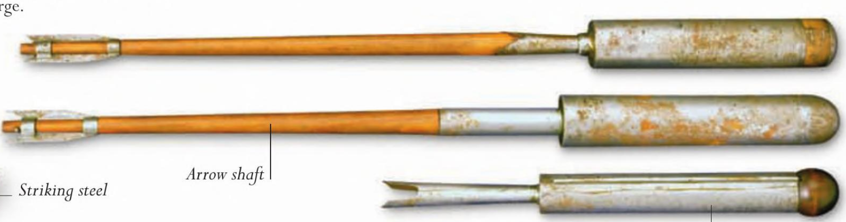
Date	1795
Origin	England
Weight	4.1kg (9lb)
Barrel	52cm (20½in)
Calibre	.39in

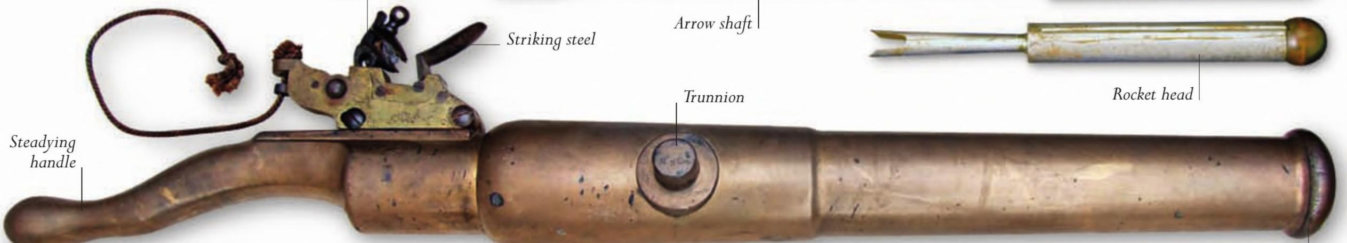
A version of this seven-barrelled volley gun was used by the British Royal Navy in close-range fighting when boarding a ship or attempting to repel enemy boarders. The central barrel fired normally, and the other six were set off by the detonation of its charge.

▼ CONGREVE ROCKETS

Date	1805
Origin	UK
Weight	14.5kg (32lb)
Length	1.03m (3¼ft)

William Congreve's rockets were propelled by black powder and could be fitted with incendiary or shrapnel heads weighing 1.4–10.9kg (3–24lb). Their accuracy could be poor and they were prone to exploding prematurely.

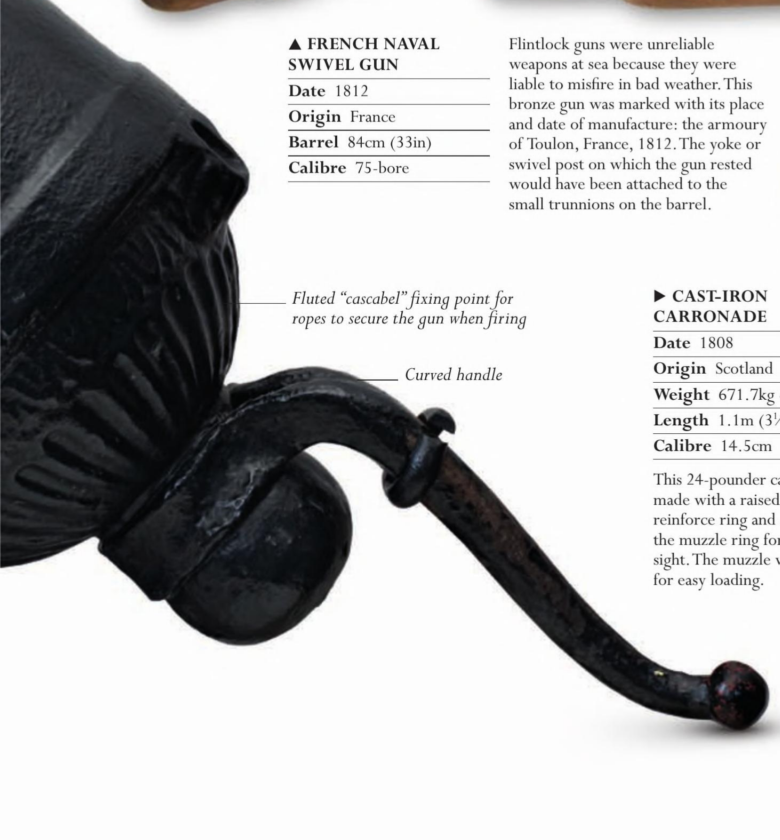

Arrow shaft
Rocket head

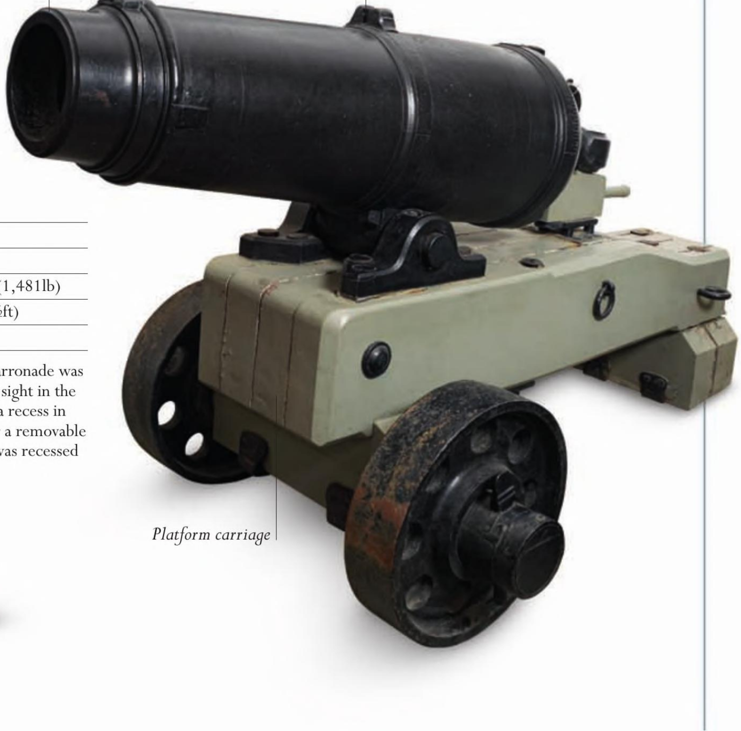

Cock
Striking steel
Trunnion
Steadying handle
Muzzle

▲ FRENCH NAVAL SWIVEL GUN

Date	1812
Origin	France
Barrel	84cm (33in)
Calibre	75-bore

Flintlock guns were unreliable weapons at sea because they were liable to misfire in bad weather. This bronze gun was marked with its place and date of manufacture: the armoury of Toulon, France, 1812. The yoke or swivel post on which the gun rested would have been attached to the small trunnions on the barrel.


Fluted "cascabel" fixing point for ropes to secure the gun when firing
Curved handle


Muzzle
Raised sight
Platform carriage

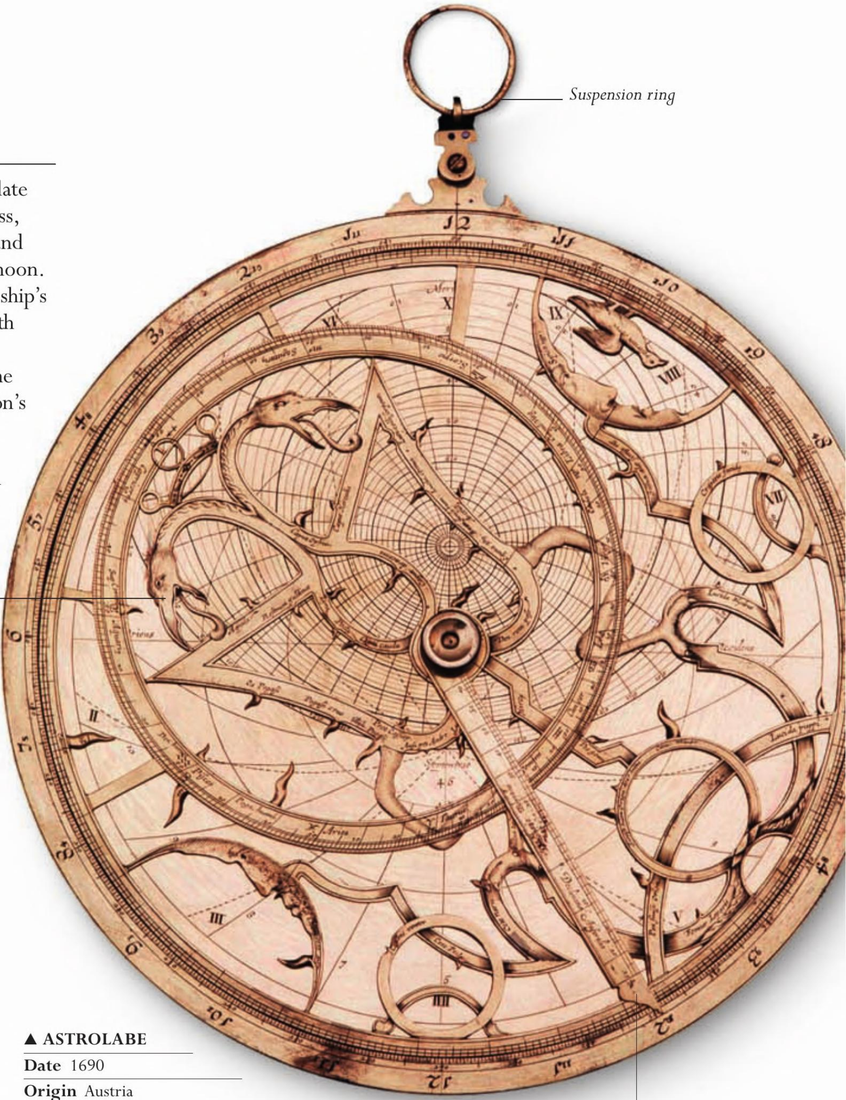
▶ CAST-IRON CARRONADE

Date	1808
Origin	Scotland
Weight	671.7kg (1,481lb)
Length	1.1m (3½ft)
Calibre	14.5cm

This 24-pounder carronade was made with a raised sight in the reinforce ring and a recess in the muzzle ring for a removable sight. The muzzle was recessed for easy loading.

NAVIGATION AND COMMUNICATION AT SEA

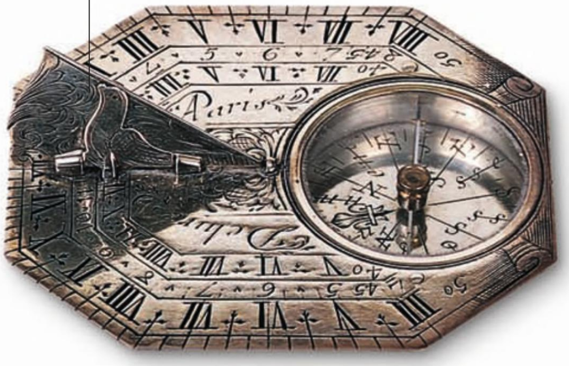
Specialized tools were used at sea to communicate signals, calculate position, and plot navigational routes. Aside from the magnetic compass, the navigator's principal tools were instruments such as the astrolabe and sextant, used for measuring the altitude of the Pole Star or the sun at noon. In conjunction with astronomical almanacs, these readings indicated the ship's latitude (how far north or south of the equator it was). Until the mid-18th century, longitude (a ship's east–west position) was calculated by "dead reckoning", using the ship's direction of travel and its speed. However, the invention of timepieces of unprecedented accuracy, such as John Harrison's marine chronometer of 1730–35, and his H4 timepiece of 1759, made precise calculations of longitude possible. The difference between the time on the clock – set to the time at Greenwich in London, England – and noon – as observed from the sun's position – indicated how many degrees the ship had sailed east or west of Greenwich.



Suspension ring

Animals represent constellations or specific stars

Movable elements set to display date and time



Gnomon hinged for folding down when travelling

▲ BUTTERFIELD DIAL

Date Late 17th century

Origin France

Material Silver, glass

A Butterfield dial was a small portable sundial with an incorporated compass. The dials took their name from their inventor, Michael Butterfield (1635–1724), an English instrument-maker who worked in Paris. The gnomon (the raised blade that casts the shadow) was adjusted according to the latitude.

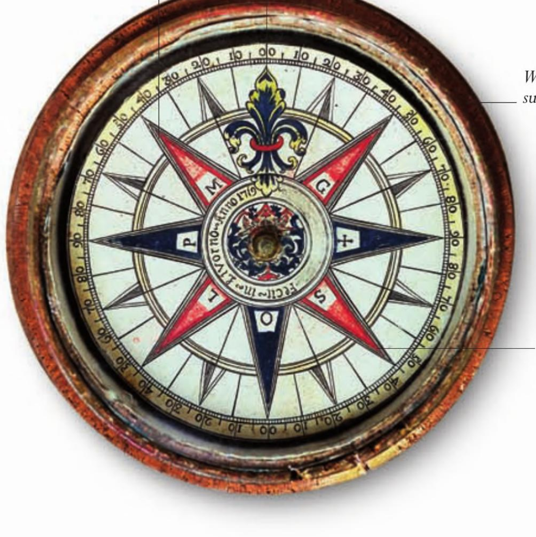
▲ ASTROLABE

Date 1690

Origin Austria

Material Brass

The astrolabe was used by medieval astronomers to observe the stars. A simplified version was adopted by mariners from c.1450 onwards.



Hand-coloured card

North point marked with a fleur-de-lys

Wooden surround

Arrow labelled "S" for the south-easterly sirocco wind

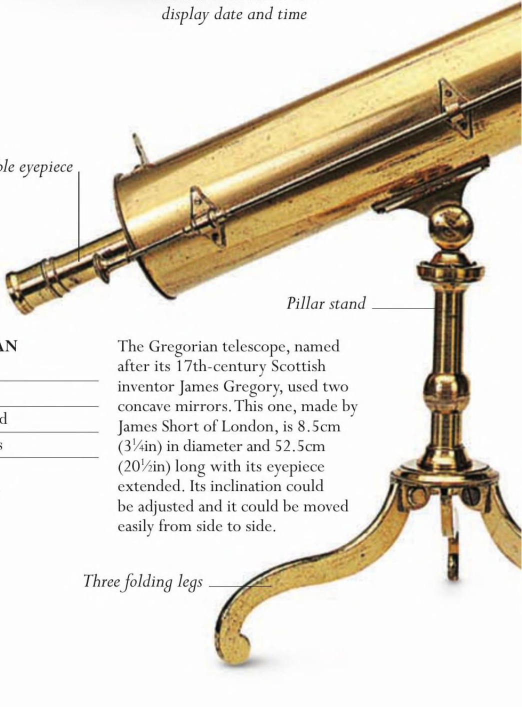
▶ NAVIGATIONAL COMPASS

Date c.1719

Origin Italy

Material Wood, card

Developed in China, the navigational compass came to be used in Europe by the 12th century. On this mariner's compass, a quadrantal degree scale runs around the outer edge of the face. The cardinal and intercardinal points are identified by the initial letter of the Italian name for the wind that blows from that direction. North is the exception, being marked by a fleur-de-lys.



Retractable eyepiece

Pillar stand

Three folding legs

▶ GREGORIAN TELESCOPE

Date 1752

Origin England

Material Brass

The Gregorian telescope, named after its 17th-century Scottish inventor James Gregory, used two concave mirrors. This one, made by James Short of London, is 8.5cm (3¼in) in diameter and 52.5cm (20½in) long with its eyepiece extended. Its inclination could be adjusted and it could be moved easily from side to side.

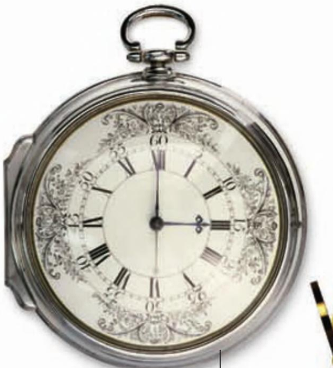
▶ H4 MARINE TIMEKEEPER

Date 1759

Origin England

Material Steel, glass, silver

The H4 watch, made by John Jefferys and based on John Harrison's design, lost just 5.1 seconds in the course of a two-month voyage from England to Jamaica, from 18 November 1761 to 19 January 1762.


Silver case

Calibrated rule

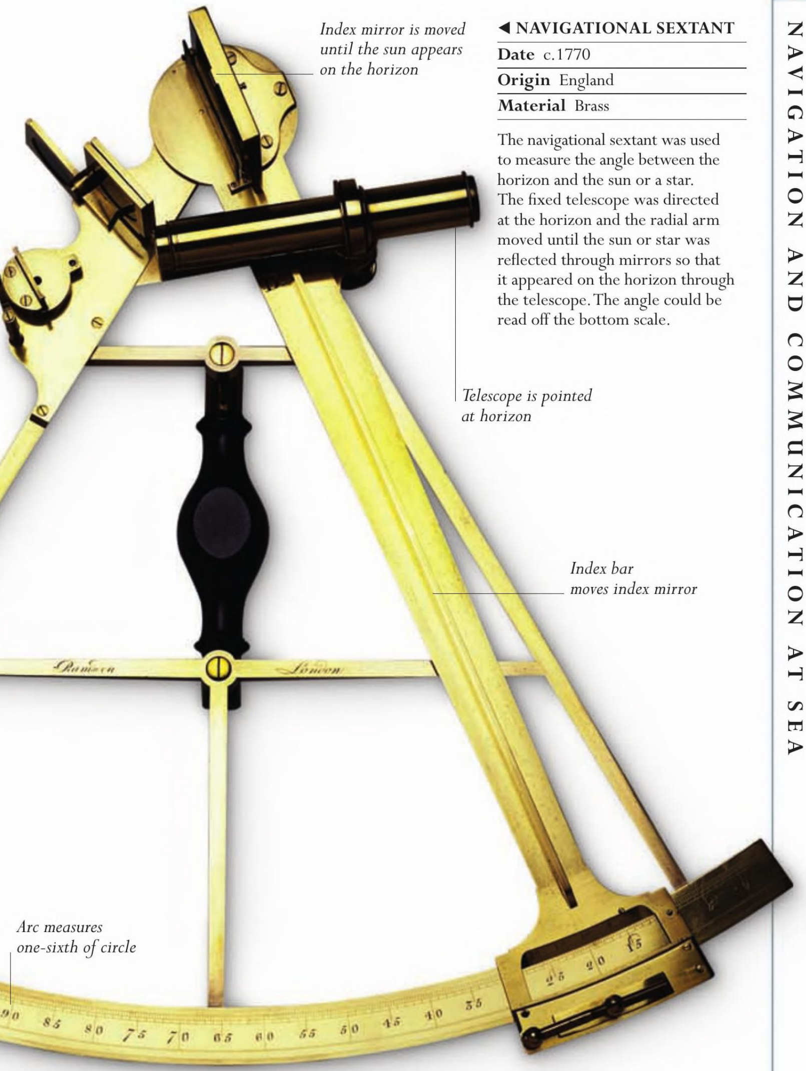
▲ DRAWING TOOLS

Date c.1780

Origin England

Material Brass, wood, leather pouch

Sets of drawing and measuring tools were used by navigators to plot their course and draw marine charts. The tools are contained in a pouch that could be closed.


Index mirror is moved until the sun appears on the horizon
Telescope is pointed at horizon
Index bar moves index mirror
Arc measures one-sixth of circle
Ramsden London
150 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 25 20 15

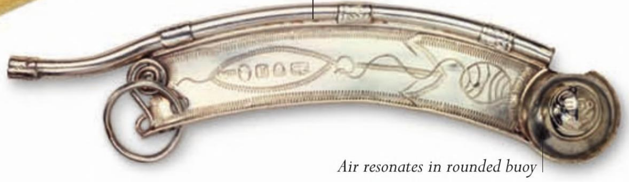
◀ NAVIGATIONAL SEXTANT

Date c.1770

Origin England

Material Brass

The navigational sextant was used to measure the angle between the horizon and the sun or a star. The fixed telescope was directed at the horizon and the radial arm moved until the sun or star was reflected through mirrors so that it appeared on the horizon through the telescope. The angle could be read off the bottom scale.


Air passes along an elongated tube called a "gun"
Air resonates in rounded buoy

▲ BOATSWAIN'S CALL

Date 1792

Origin England

Material Silver

The boatswain's call was a pipe used to convey orders aboard ship. Its shrill whistle could be heard above the sound of wind and waves. A finger was held over the hole to vary the tone – different combinations of tone and length of note signalled different orders.

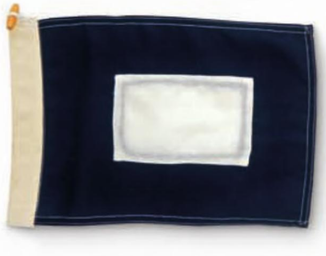
▶ BRITISH NAVAL SIGNAL FLAGS

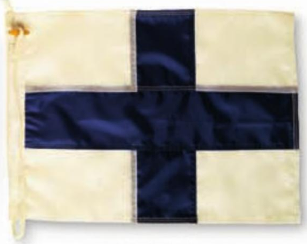
Date 1800

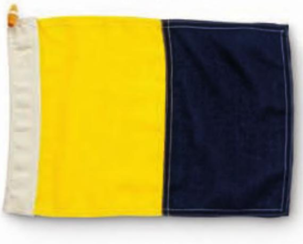
Origin England

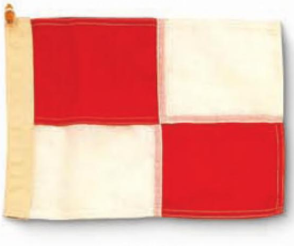
Material Linen

Signal flags were used by most navies for communication at sea, but one of the first efficient, codified systems was developed by British Admiral Sir Home Popham in 1800. His system of numerary flags preceded the International Code of Signals, which was adopted worldwide in 1889.


NUMERIC 1

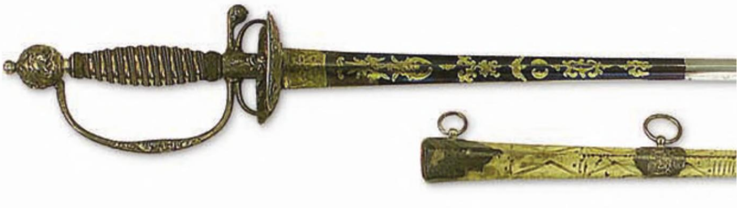

NUMERIC 2


NUMERIC 4


NUMERIC 9

NAVAL SWORDS

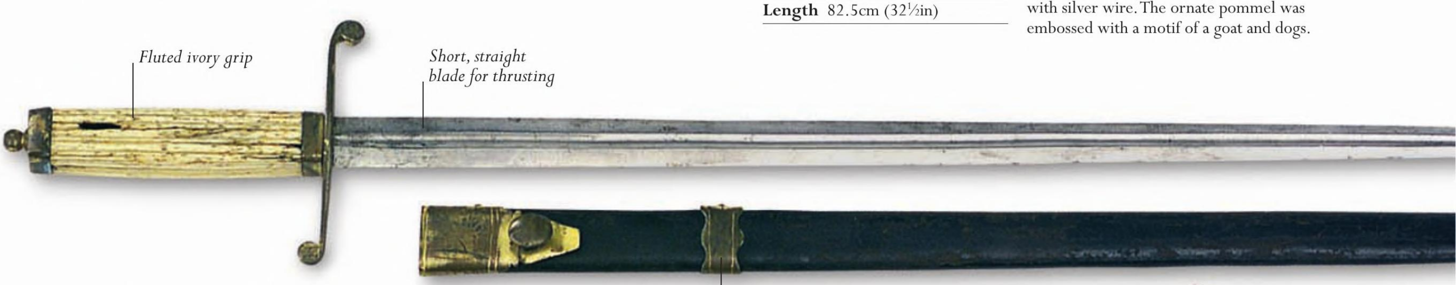
An ordinary sailor in the late 18th century made do with a simple cutlass, alongside a boarding pike, axe, and blunderbuss pistol. Naval officers, however, could choose from a wider range of swords. In addition to a short, curved sword with a plain hilt, officers' weapons included the ceremonial small sword, often worn when going ashore, and the spadroon – a light sword with a "five-ball hilt". The spadroon, with the decorative spheres on its hilt, was highly fashionable among officers in both armies and navies towards the close of the 18th century. Officers' swords also often had an anchor decoration on the hilt.



▲ SMALL SWORD

Date	1770
Origin	UK
Length	82.5cm (32½in)

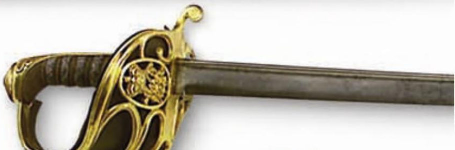
This ceremonial small sword, which probably belonged to British diplomat Sir William Hamilton (1731–1803), had a silver knuckle guard and grip bound with silver wire. The ornate pommel was embossed with a motif of a goat and dogs.


Fluted ivory grip
Short, straight blade for thrusting
Gilt scabbard band

▲ OFFICER'S DIRK

Date	1790
Origin	UK
Length	52cm (20½in)

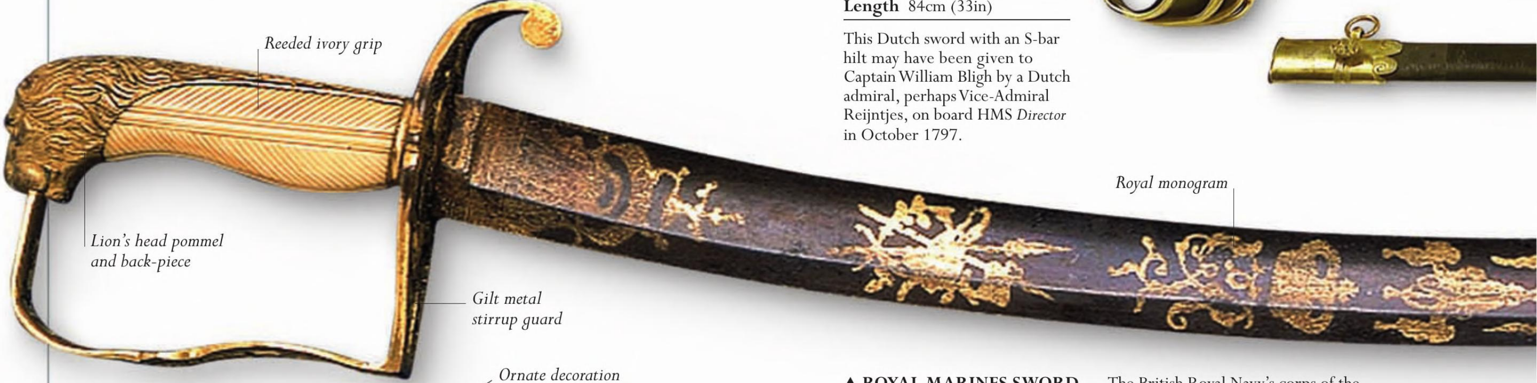
The dirk was carried by officers and midshipmen from 1750 onwards. The dagger-like sword could be used as a stabbing weapon in boarding operations.



▶ DUTCH S-BAR HILTED SWORD

Date	1797
Origin	Netherlands
Length	84cm (33in)

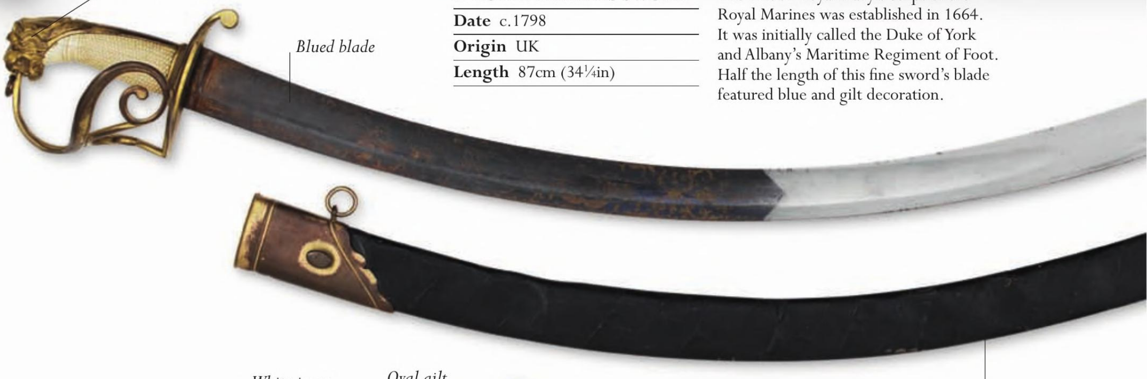
This Dutch sword with an S-bar hilt may have been given to Captain William Bligh by a Dutch admiral, perhaps Vice-Admiral Reijntjes, on board HMS *Director* in October 1797.


Reeded ivory grip
Royal monogram
Lion's head pommel and back-piece
Gilt metal stirrup guard

▲ ROYAL MARINES SWORD

Date	c.1798
Origin	UK
Length	87cm (34¼in)

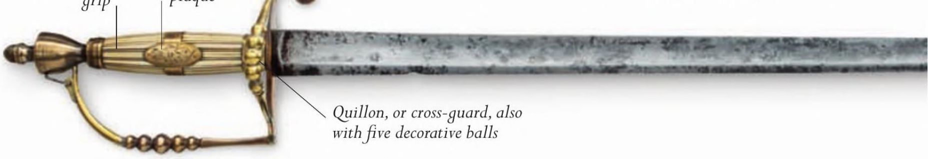
The British Royal Navy's corps of the Royal Marines was established in 1664. It was initially called the Duke of York and Albany's Maritime Regiment of Foot. Half the length of this fine sword's blade featured blue and gilt decoration.


Ornate decoration
Blued blade
Leather scabbard

▶ NAVAL OFFICER'S SWORD

Date	1790
Origin	UK
Weight	935g (33oz)
Length	85cm (33½in)

Many of the ceremonial swords worn by naval officers featured etched designs, gilding, and a "blued" blade. Gold and mercury were used in the gilding, and when the blade was fired, the mercury evaporated, leaving the gold design highlighted against a dark background. English swordsmiths were renowned around the globe for their skill in these techniques.


White ivory grip
Oval gilt plaque
Quillon, or cross-guard, also with five decorative balls

▶ FIVE-BALL SPADROON

Date	c.1790
Origin	UK
Length	80.5cm (31½in)

This five-ball spadroon, or light sword, was straight-bladed with a "five-ball hilt" – the "five-ball" referring to the decorative spheres on the hilt's knuckle guard and counter-guard.

Triangular-section blade
Metal chape
Gilt locket with suspension ring

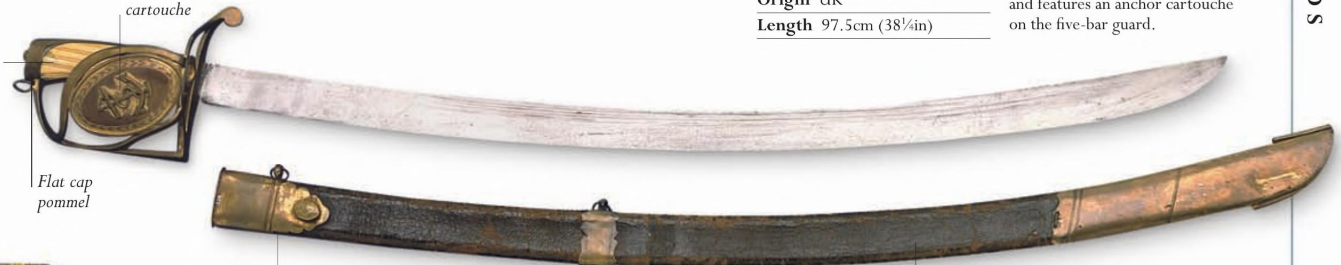
▼ S-BAR NAVAL SWORD

Date c.1800

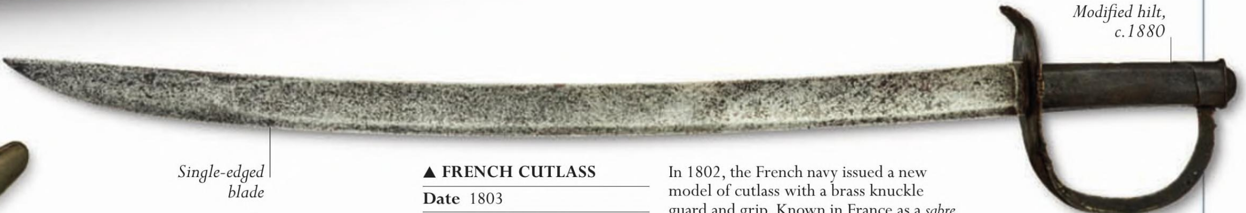
Origin UK

Length 97.5cm (38¼in)

This S-bar hilted sword – used by naval officer Captain W Holt in the early 1800s – has a curved blade, and features an anchor cartouche on the five-bar guard.


Anchor cartouche
Ivory grip
Flat cap pommel
Gilt brass locket
Black leather scabbard

Suspension ring
Scabbard
Flattened tip
Etched designs on blued blade


Modified hilt, c.1880
Single-edged blade

▲ FRENCH CUTLASS

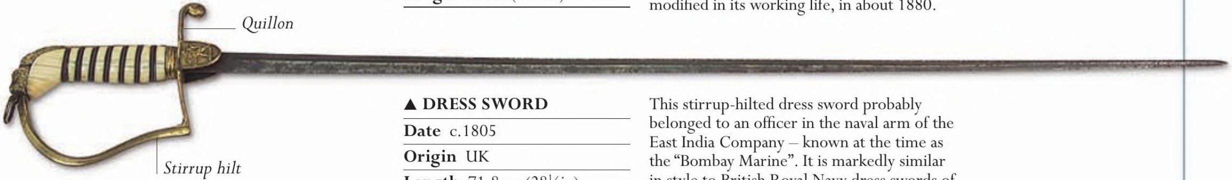
Date 1803

Origin France

Weight 907g (32oz)

Length 81cm (31¾in)

In 1802, the French navy issued a new model of cutlass with a brass knuckle guard and grip. Known in France as a *sabre d'abordage* (boarding sabre), the cutlass was a wide-bladed slashing sword with either a straight or slightly curved blade. The hilt was modified in its working life, in about 1880.


Quillon
Stirrup hilt

▲ DRESS SWORD

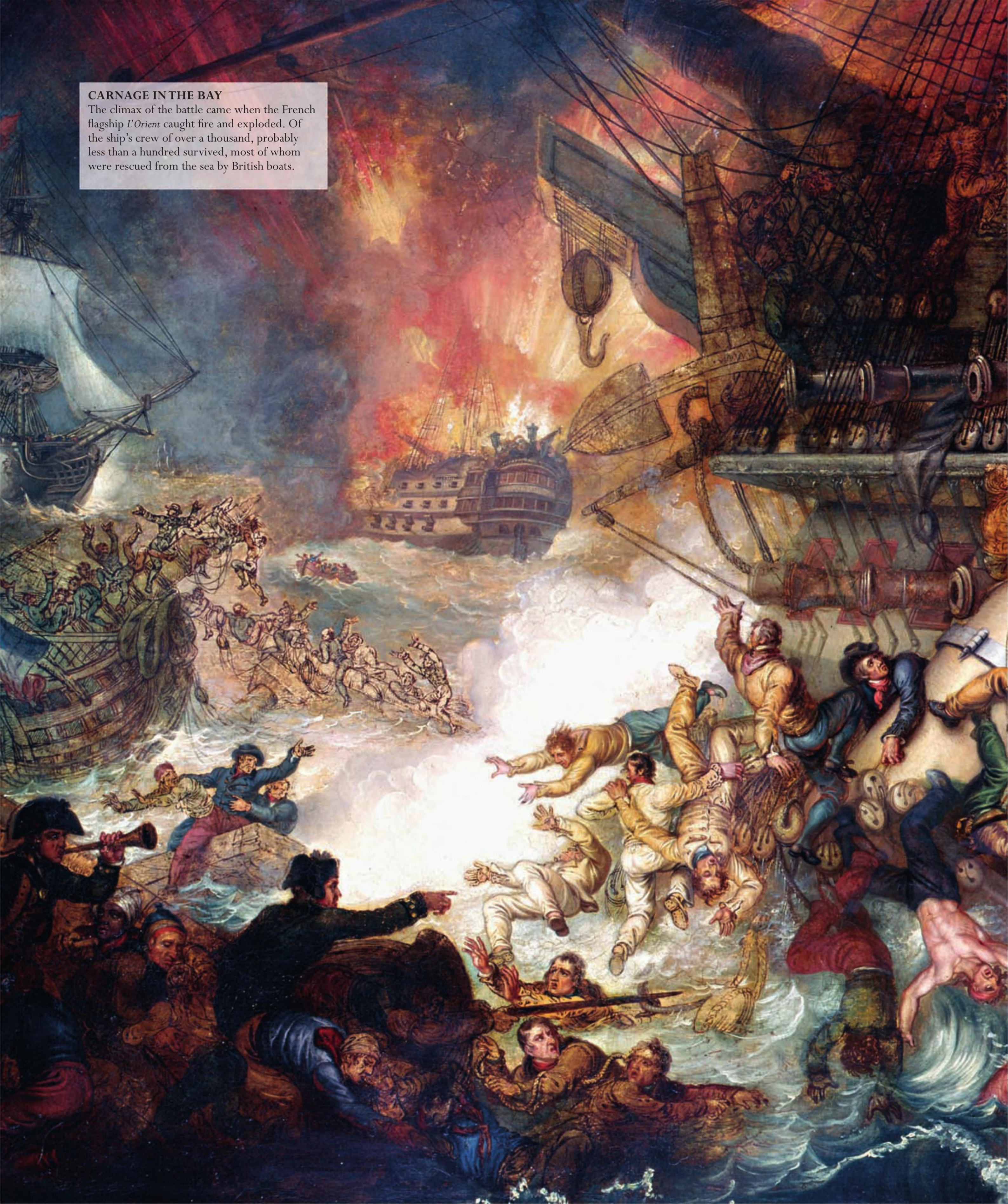
Date c.1805

Origin UK

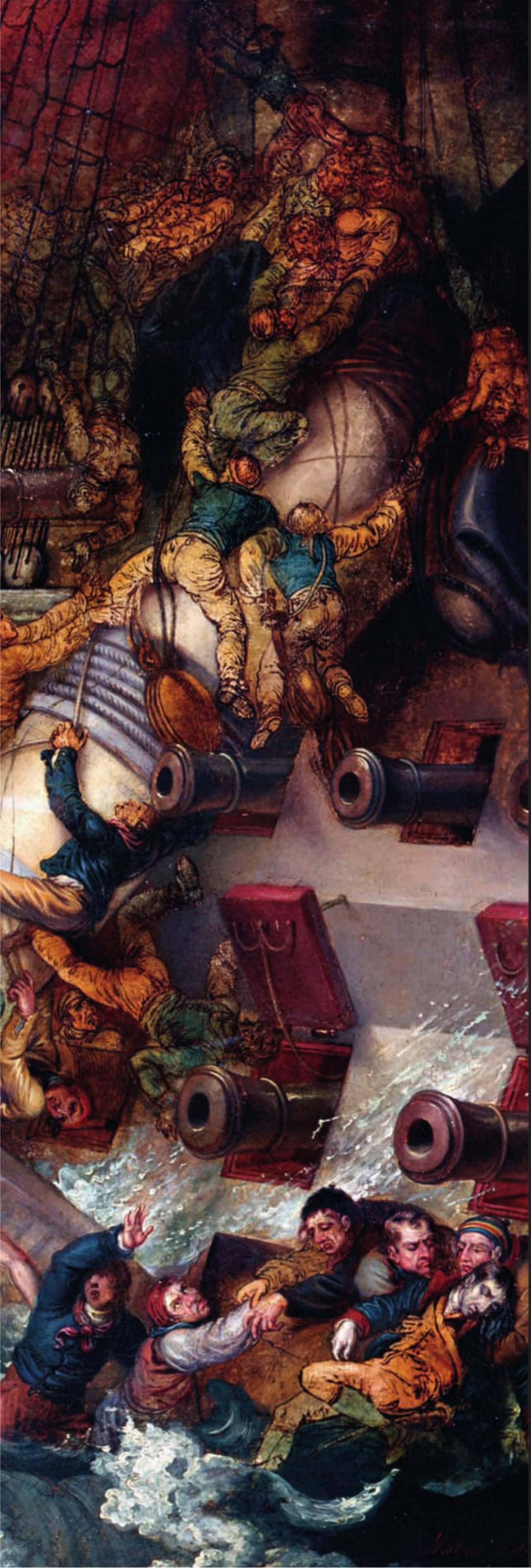
Length 71.8cm (28¼in)

This stirrup-hilted dress sword probably belonged to an officer in the naval arm of the East India Company – known at the time as the "Bombay Marine". It is markedly similar in style to British Royal Navy dress swords of the early 19th century.

Single-edged steel blade



CARNAGE IN THE BAY
The climax of the battle came when the French flagship *L'Orient* caught fire and exploded. Of the ship's crew of over a thousand, probably less than a hundred survived, most of whom were rescued from the sea by British boats.



NAVAL COMBAT IN THE AGE OF SAIL

THE BATTLE OF THE NILE

The victories of British Rear-Admiral Horatio Nelson are among the most renowned examples of naval combat in the age of sailing ships. At Aboukir Bay in 1798, Nelson demolished a French fleet with a typically risky attack that rewrote the rules and tactics of fighting in line.

During the French Revolutionary War, the French fleet escorted General Napoleon Bonaparte's expeditionary force from France to Egypt. By 1 August 1798, 13 French ships of the line and four frigates were anchored at Aboukir Bay, on the Egyptian coast near Alexandria.

Britain's Admiral Lord Nelson had been seeking to intercept Bonaparte's troop convoy, chasing it with his 14 ships of the line. The ships, with one exception, were all 74-gun. On the afternoon of 1 August his lookouts sighted the French fleet, which had adopted an apparently impregnable defensive position: the ships were anchored in line of battle with their port side close to the shore, ready to fire broadsides to starboard. The French fleet was also mainly composed of 74-gun ships, but the fleet's commander, Admiral François-Paul Brueys, had a flagship, *L'Orient,* that was larger than any of the British ships – a massive 120-gun three-decker. Meanwhile, the shallow bay had numerous unmarked sandbanks and shoals that any attacker would need to negotiate with care.

Nelson decided to attack at once, although it was late in the day, focusing on the leading French ships (the van) and the centre of the fleet. Due to wind direction, the ships of the French rear would be unable to join the fight, leaving the British with a local superiority in numbers.

When the British ships sailed into the bay it was nearly sunset. Many French sailors had been ashore and were still hurrying to rejoin their ships. Only one British vessel came to grief on a shoal, a tribute to the quality of Royal Navy seamanship. Five British ships sailed around the head of the French line and into the shallow water between the French ships and the shore. This manoeuvre took the French entirely by surprise – the gunports on the landward side of their ships were closed. Nelson's ships also sailed into position on the seaward side of the French van, trapping each of the five French ships between a pair of British vessels. Shattered by point-blank broadsides from port and starboard, the French ships were soon in a desperate state.

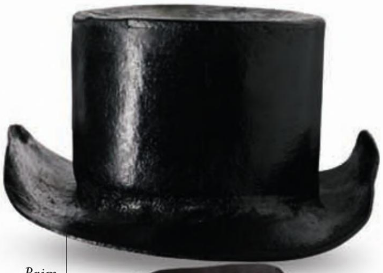
The British attack on the French centre, however, did not go as well at first. *L'Orient* dismasted *Bellerophon* by firing repeated broadsides, and the crippled ship drifted out of the battle. Nelson, standing in full view on the deck of his flagship *Vanguard* – as was customary – was cut across the forehead by a metal shard.

DESTRUCTION AND DEFEAT

The fighting continued after dark, and the valiant resistance of the French fleet began to fail. At around 10pm, *L'Orient* caught fire and when the flames reached the ship's powder magazine it exploded, scattering burning wreckage over a wide area. Admiral Brueys was already dead, cut almost in half by a cannon shot. During the night the fighting died down, and dawn broke over a scene of desolation: wreckage and dismembered bodies filled the bay. The ships in the rear of the French line had remained mere spectators of the carnage, while several French vessels had slipped away in the night. Nelson had destroyed two French ships of the line and captured nine.

WEAPONS, UNIFORM, AND KIT OF AN ORDINARY BRITISH SAILOR

The phenomenal success of British sea power in the French Revolutionary and Napoleonic Wars depended not only on the tactical genius of commanders, but also on the bravery of the Royal Navy's well-drilled seamen, or "Jack Tars". Ordinary sailors' onboard duties chiefly involved the upkeep and running of the ship and the firing of its guns, although the men were issued with a pike, axe, cutlass, and pistols for boarding raids. A Jack Tar did not have a uniform, but he would have been identifiable from his outfit, which typically included a checked shirt, a short jacket, and a waistcoat.



Brim, usually of narrow width

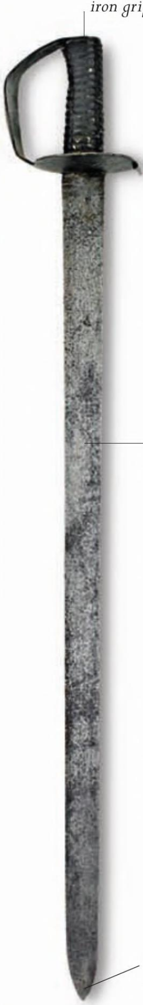
▶ ROUND HAT

Date c.1800

Origin England

Material Tarred straw

Sailors sported a variety of headgear. Straw hats, popular in sunny latitudes, were often tarred to make them waterproof. The "round hat" had a tall crown like that of a top hat.



Black-painted iron grip

Straight, almost flat steel blade

Blade tapered to stabbing point

◀ NAVAL CUTLASS MODEL 1804

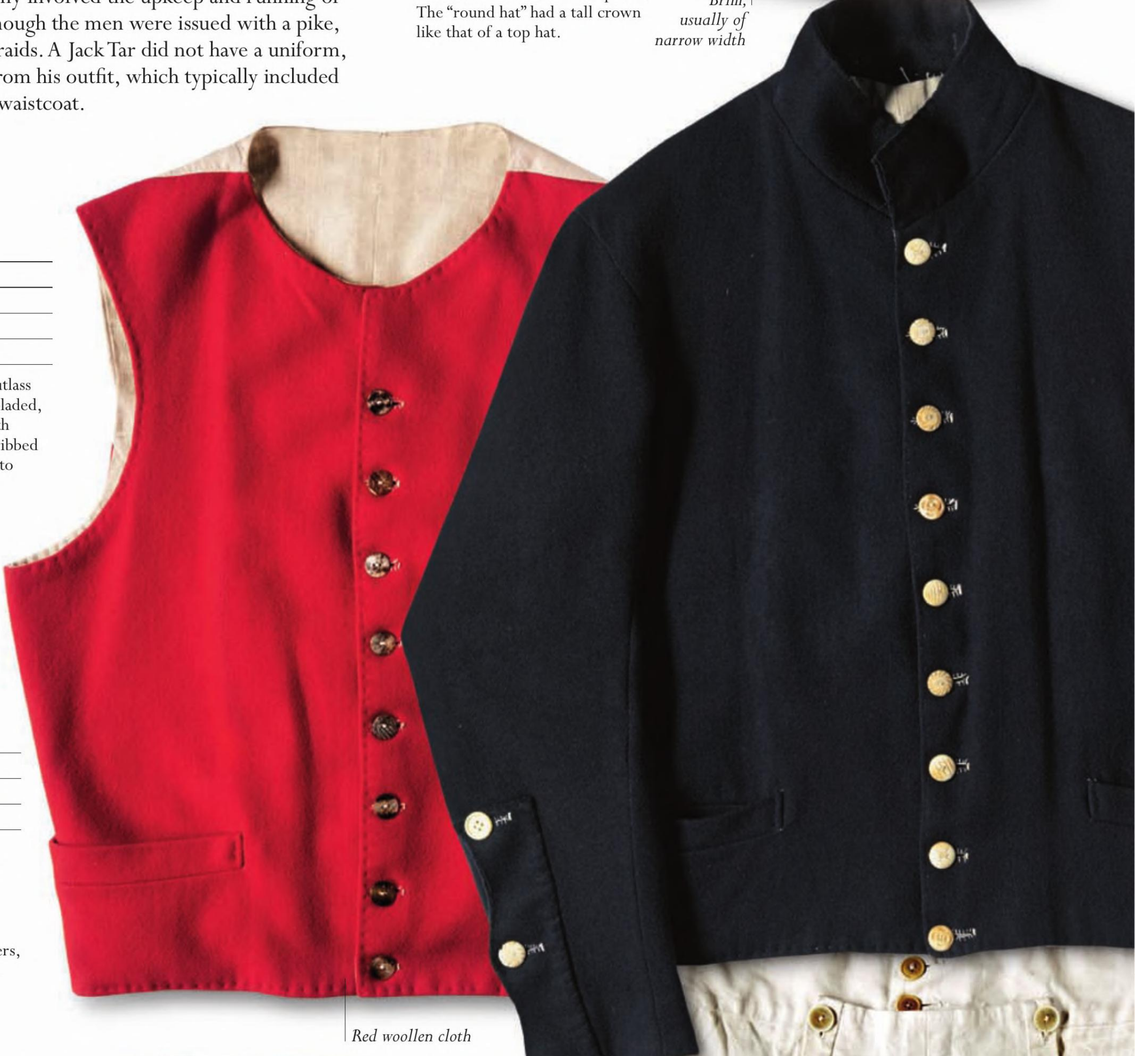
Date 1804

Origin England

Weight 1.32kg (3lb)

Length 85.5cm (33½in)

The British Model 1804 cutlass was a utilitarian, straight-bladed, cut-and-thrust weapon with a double disc guard and a ribbed iron handle, painted black to protect against corrosion.



Red woollen cloth

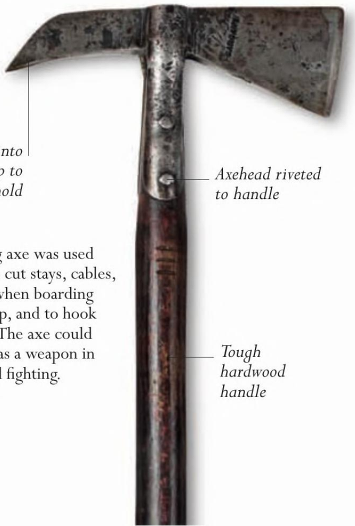
▶ WAISTCOAT

Date c.1800

Origin England

Material Wool

A colourful waistcoat was a fairly standard piece of clothing for seamen. Being skilled at repairing sails, many sailors were accomplished needleworkers, making and mending most of their own clothes.



Spike could be driven into hull of an enemy ship to make a step or handhold

Axehead riveted to handle

Tough hardwood handle

▶ BOARDING AXE

Date c.1800

Origin England

Weight 1.8kg (4lb)

Length 1m (3¼ft)

The boarding axe was used by seamen to cut stays, cables, and rigging when boarding an enemy ship, and to hook away debris. The axe could also be used as a weapon in hand-to-hand fighting.

▶ TROUSERS

Date c.1800

Origin England

Material Cotton

Seamen generally wore loose trousers for ease of movement. They favoured "white duck", a hard-wearing cotton weave, and the trousers could be of any colour or pattern – many were striped.

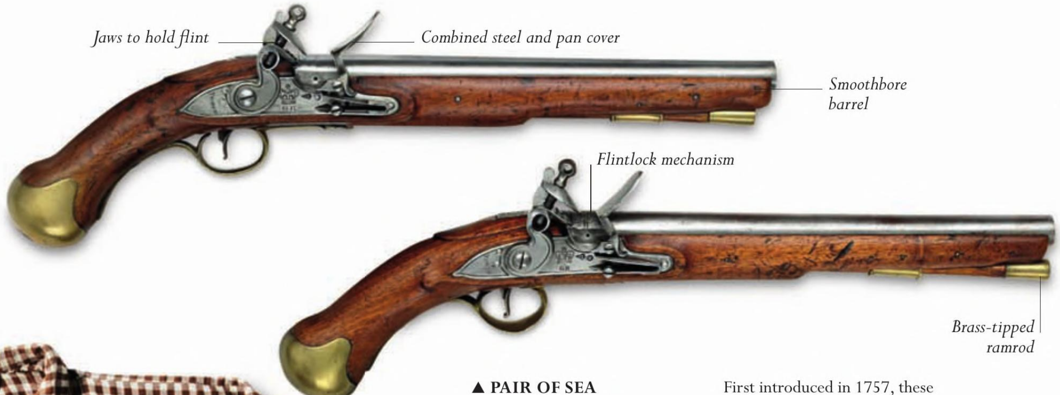
▼ JACKET

Date c.1800

Origin England

Material Linen

A sailor's jacket was short with no tails, and usually blue. Sailors often bought material or clothes from the same outfitter or from the ship's purser, so there was considerable uniformity in their appearance.



Jaws to hold flint

Combined steel and pan cover

Smoothbore barrel

Flintlock mechanism

Brass-tipped ramrod

▲ PAIR OF SEA SERVICE PISTOLS

Date c.1790

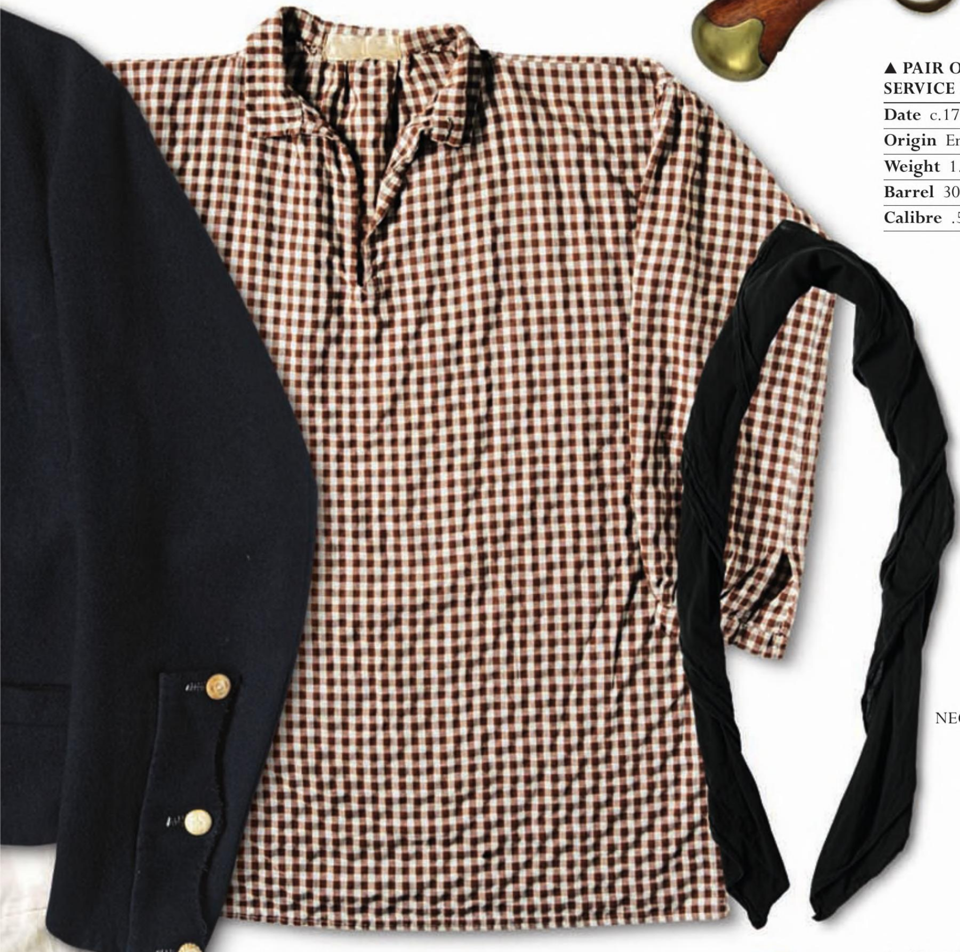
Origin England

Weight 1.1kg (2½lb)

Barrel 30cm (12in)

Calibre .56in

First introduced in 1757, these pistols are of the Pattern 1757/1777 type. Pistols issued to sailors were normally fired only once – in the initial attack or as a last resort. The pistol's brass butt could also be used as a club.



◀ SHIRT AND NECK CLOTH

Date c.1800

Origin England

Material Linen

A checked shirt and neck cloth were the hallmarks of a Royal Navy seaman. The neck cloth could double as a bandanna tied around the head to keep sweat out of the eyes.

NECK CLOTH

Brass or yellow metal buttons

Smooth shaft to avoid tangling in netting and rigging

▶ BOARDING PIKE

Date c.1800

Origin England

Weight 3kg (6½lb)

Length 2.4m (8ft)

Pikes were kept in a rack on the main deck. They were handy weapons in the mêlée of confused fighting that ensued when a ship was boarded.

▲ BELT

Date c.1800

Origin England

Material Leather

To keep his cotton-weave trousers in place, a seaman usually wore a simple, wide, black leather belt with a brass buckle.

Buckle and strap fastening

Shoes issued in standard sizes

◀ BUCKLED SHOES

Date c.1800

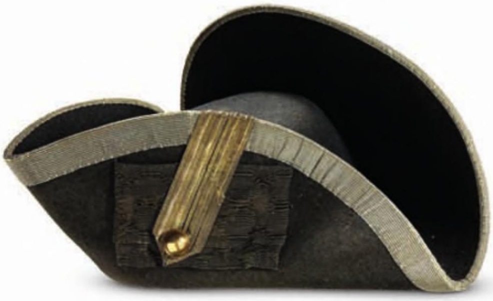
Origin England

Material Leather

Although sailors went barefoot much of the time on board, they would put on their best pair of shoes for the captain's inspection and church service on Sunday.

BRITISH NAVAL OFFICERS' UNIFORM

The British Royal Navy's officer class in the 18th and early 19th centuries was primarily made up of men as young as 12 to 14 years of age who came from respectable backgrounds. The Navy offered a tempting career during wartime, despite the hazards of life at sea. In addition to opportunities for promotion, there was the chance to become rich from the prize money paid by the Admiralty to those officers and crew who took possession of enemy ships. These young recruits initially learned how to navigate and operate a warship as midshipmen. They would hope for promotion to lieutenant after around six years, and for command of their own ship by the age of 21. Uniforms for officers, predominantly in white and navy blue, were first issued in 1748, and a new pattern was introduced in 1774.



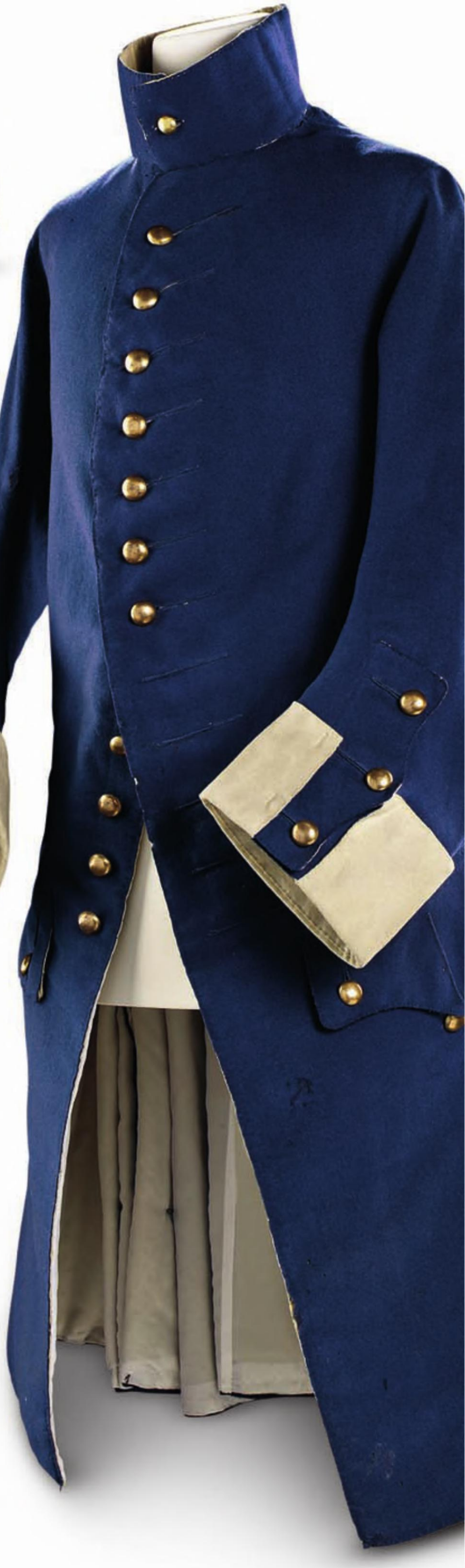
▲ CAPTAIN'S HAT

Date c.1750

Origin England

Material "Half-beaver" felt

A captain would usually carry his hat under his arm so that his wig was not displaced. The material was "half-beaver" – a type of felt with beaver hair added to increase its firmness. The hat was then lined with silver lace.



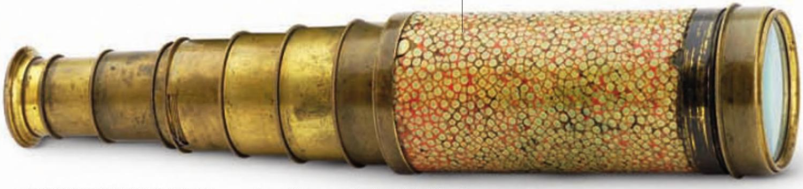
▶ MIDSHIPMAN'S FROCK COAT

Date 1748

Origin England

Material Wool, velvet

The "mariner's cuff" in white with a three-point blue section was widely fashionable beyond the Royal Navy, appearing in suits and riding clothes as well. The wool collar is lined with white velvet.



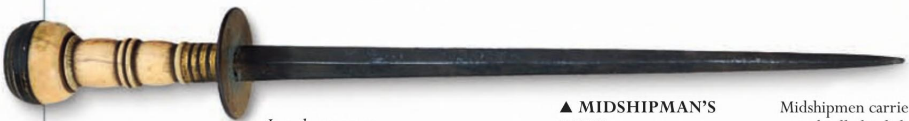
▲ OFFICER'S TELESCOPE

Date c.1800

Origin England

Material Glass, brass, rayskin, sharkskin

An officer used a hand-held telescope to identify approaching vessels, view flag signals, and help him gauge possible navigational hazards. This telescope had seven draw tubes, and the eyepiece cover, draw tubes, and fittings were made of brass. It could be retracted and fitted into a sharkskin case.



▲ MIDSHIPMAN'S DIRK

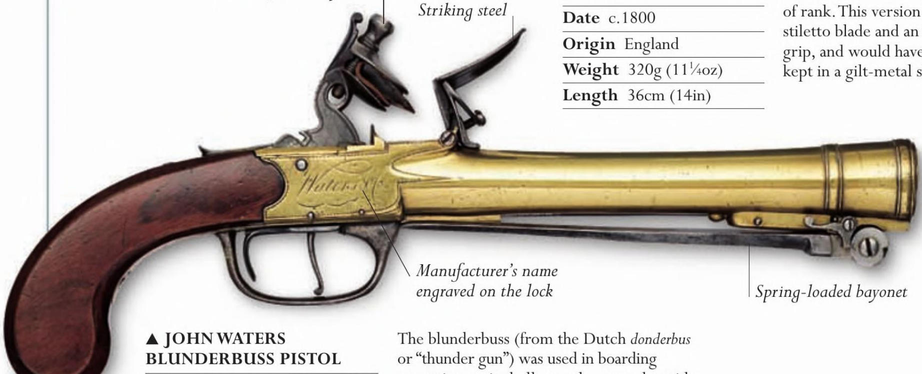
Date c.1800

Origin England

Weight 320g (11¼oz)

Length 36cm (14in)

Midshipmen carried a short sword called a dirk as a mark of rank. This version has a stiletto blade and an ivory grip, and would have been kept in a gilt-metal sheaf.



▲ JOHN WATERS BLUNDERBUSS PISTOL

Date 1785

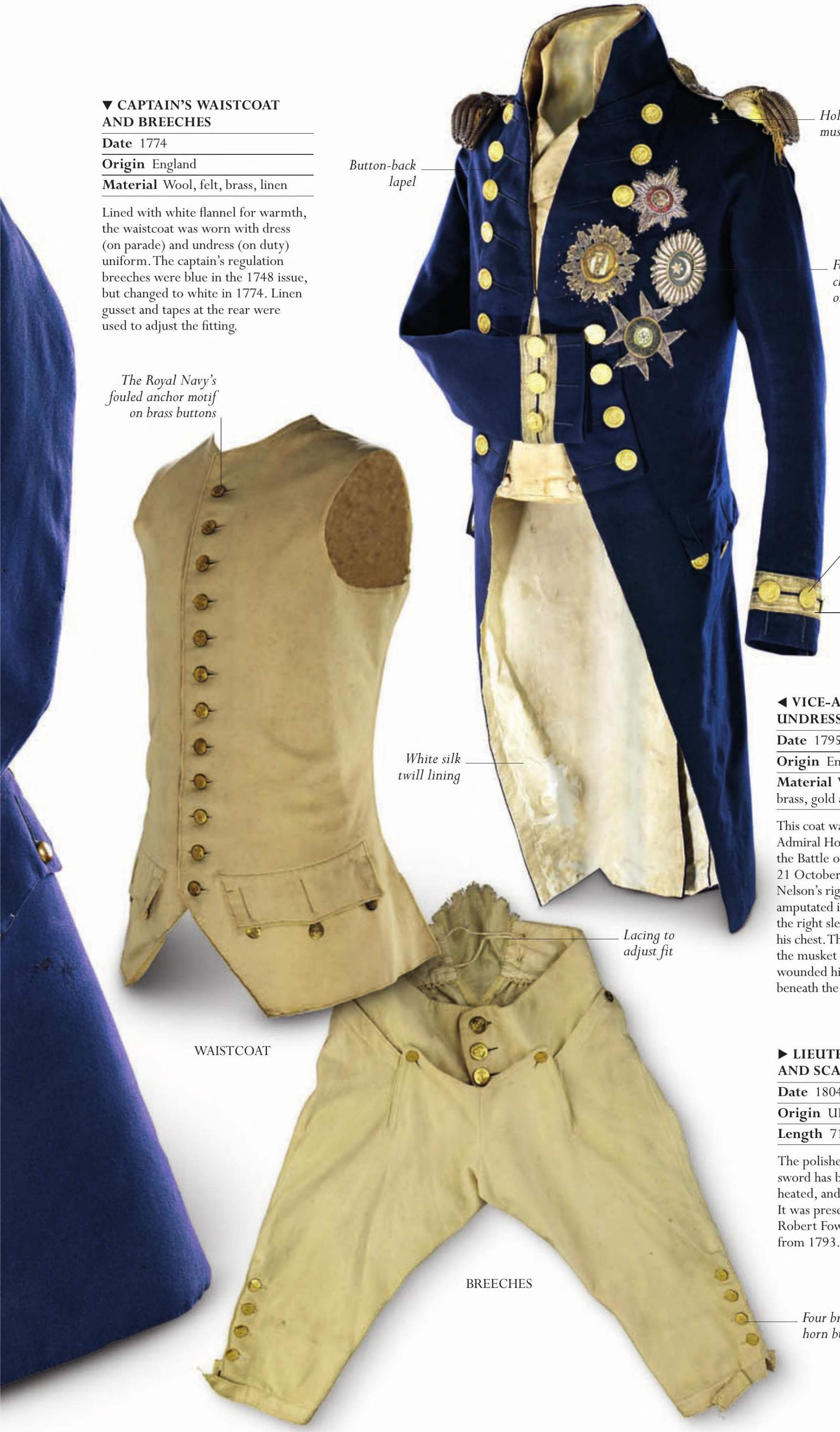
Origin England

Weight 950g (33½oz)

Barrel 19cm (7½in)

Calibre 1in

The blunderbuss (from the Dutch *donderbus* or "thunder gun") was used in boarding operations – its bell-mouth ensured a wide spread of shot when fired at close quarters. This box-lock model was made by John Waters of Birmingham, who held the patent on the pistol bayonet. His name is legible on the rectangular box enclosing the lock mechanism.


The Royal Navy's fouled anchor motif on brass buttons
Button-back lapel
Hole made by musket ball
Four orders of chivalry sewn onto the coat
Fouled anchor motif on buttons
Gold distinction lace
White silk twill lining
Lacing to adjust fit
WAISTCOAT
BREECHES
Four brass-covered horn buttons

▼ CAPTAIN'S WAISTCOAT AND BREECHES

Date 1774

Origin England

Material Wool, felt, brass, linen

Lined with white flannel for warmth, the waistcoat was worn with dress (on parade) and undress (on duty) uniform. The captain's regulation breeches were blue in the 1748 issue, but changed to white in 1774. Linen gusset and tapes at the rear were used to adjust the fitting.

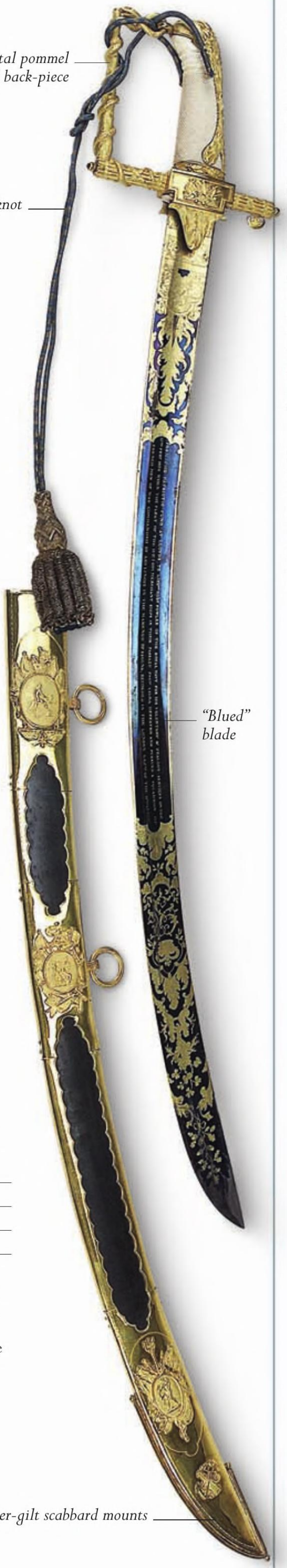
◀ VICE-ADMIRAL'S UNDRESS COAT

Date 1795

Origin England

Material Wool, silk, brass, gold alloy

This coat was worn by British Admiral Horatio Nelson at the Battle of Trafalgar on 21 October 1805. Because Nelson's right arm had been amputated in 1797, he wore the right sleeve pinned across his chest. The hole made by the musket ball that fatally wounded him is visible just beneath the left epaulette.


Gilt metal pommel and back-piece
Sword knot
"Blued" blade
Copper-gilt scabbard mounts

▶ LIEUTENANT'S SWORD AND SCABBARD

Date 1804

Origin UK

Length 71cm (28in)

The polished steel blade of this sword has been "blued" by being heated, and is decorated with gilt. It was presented to Lieutenant Robert Fowler, who was in service from 1793.

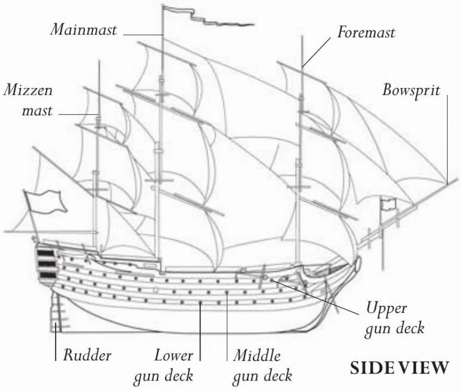
18TH-CENTURY SHIP OF THE LINE

HMS VICTORY

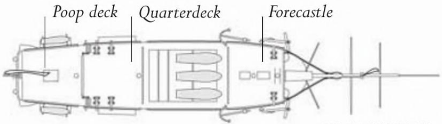
A first-rate ship of the line, the *Victory* won fame as Admiral Horatio Nelson's flagship when the British Royal Navy triumphed over the Spanish and French fleets at the Battle of Trafalgar, in 1805.

More than 6,000 trees – mostly oak – were felled for *Victory*'s construction. Launched in 1765, it was not commissioned until war with France broke out in 1778, and the ship saw its first action at the Battle of Ushant. It later became the Royal Navy's flagship in the Mediterranean and led the action that destroyed the Spanish fleet at the Battle of Cape St Vincent, in 1797. By then the *Victory* was showing its age, so at the end of 1797 it was retired to serve as a hospital ship. This decision was soon reconsidered, and, after being repaired, the *Victory* was recommissioned as Nelson's flagship, in 1803. Two years later it played a key role in the Battle of Trafalgar, with 57 men killed, including her admiral, and 102 injured. The ship remained in active service until 1812.

The *Victory* carried 820 men, including 146 marines. Its 104 smoothbore, muzzle-loading cannon gave it immense firepower: in comparison, the entire French army at the Battle of Austerlitz, in the same year as Trafalgar, fielded 139 cannon.



SIDE VIEW



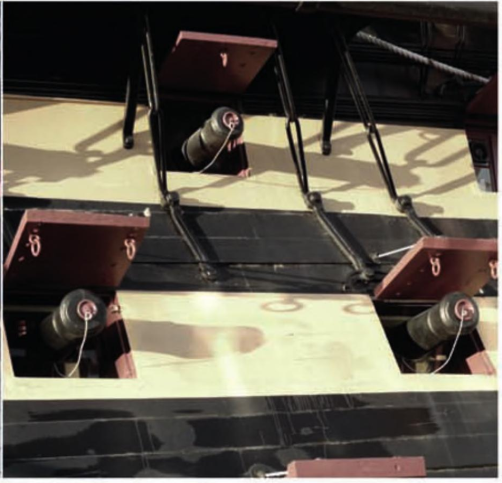
PLAN VIEW

▲ **HMS *VICTORY***
The ship was up to 16m (52ft) wide, and the gun-deck length was 57m (187ft). The 37 sails had a combined area of 5,468 sq m (6,510 sq yards).

TOWARDS THE STERN

◀ **STERN**
Housed in the rear of the ship were the cabins of the admiral, captain, and other officers. There was less decoration on the *Victory*'s stern than on earlier ships of her kind.

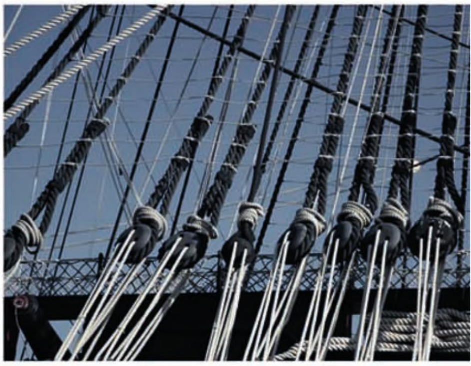
▲ **WHEEL AND BINNACLE**
The double wheel, located aft on the quarterdeck and under the poop, was operated by four men in calm weather and up to eight in a storm. The binnacle, in front of the wheel, holds a lantern and two compasses.



▲ **GUN PORTS**
The ports were opened and closed using ropes located on the gun decks. The muzzles of the guns are blocked by tompions (plugs that are designed to keep out dust and moisture).

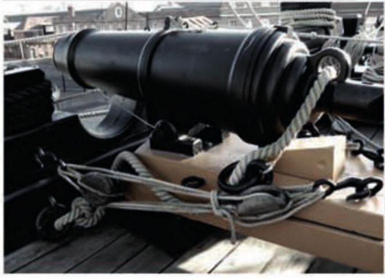
MASTS AND RIGGING

▲ **MAINMAST**
The three masts are supported by ropes called standing rigging. With men climbing along the yard arms to set or furl the sails, fatal falls were common.



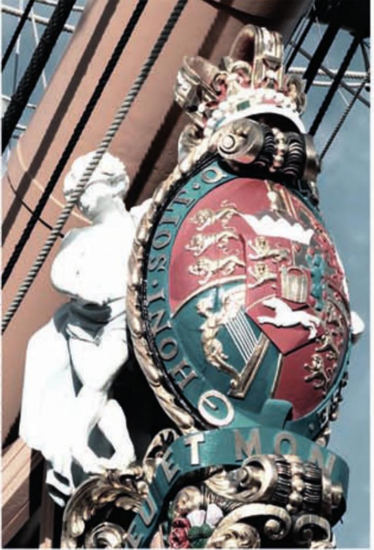
▲ **ROPE LADDER**
"Shrouds" are standing rigging ropes fitted to the ship's sides; "ratlines" run across them, forming ladders up the masts.

TOWARDS THE PROW



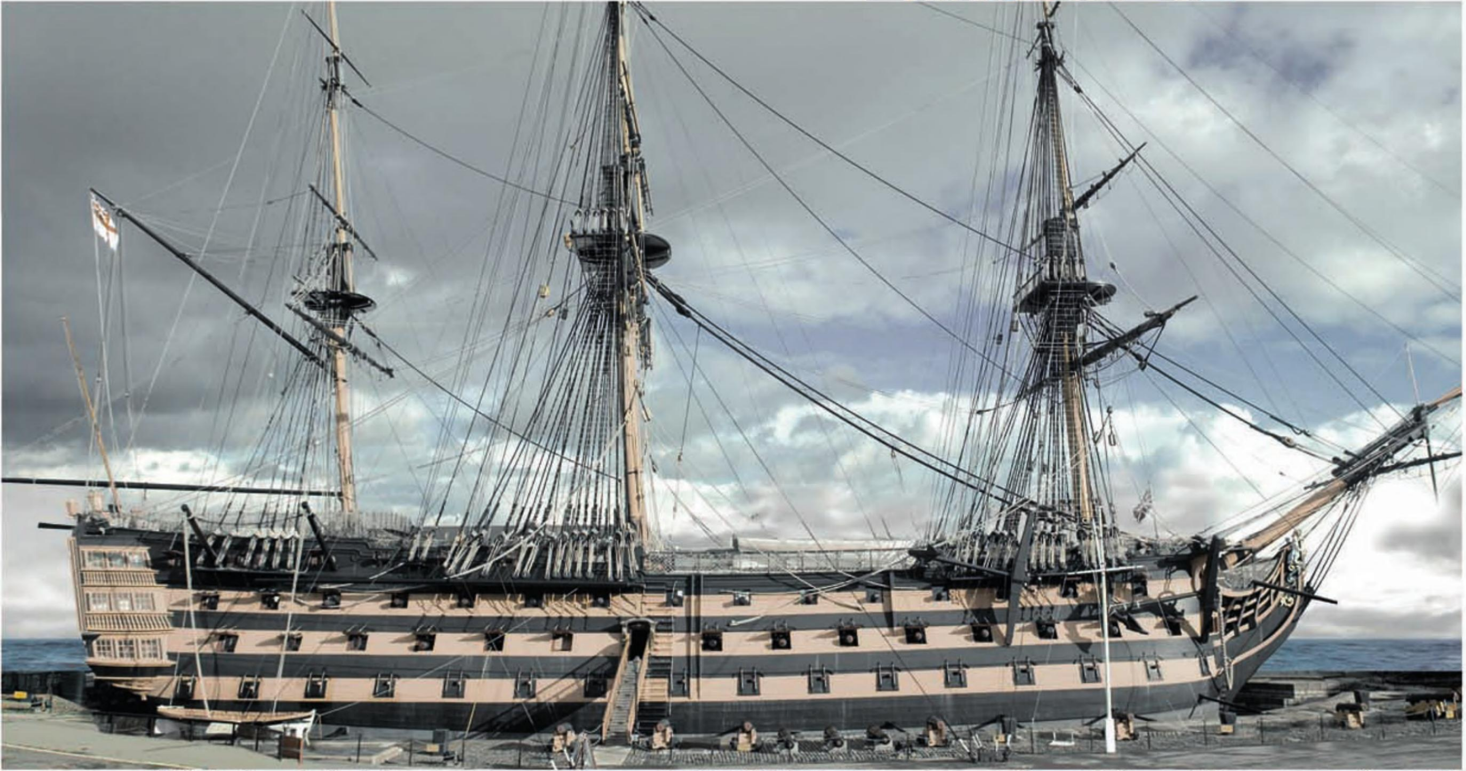
▲ **CARRONADE**
Two powerful short-barrelled guns known as carronades were mounted on the forecastle. They were devastating at close range.

▲ **HEAVY ANCHOR**
The largest of the seven anchors weighed more than 4½ tons and required 144 men to raise it.



◄ **FIGUREHEAD**
Supported by two cupids, the royal coat of arms was topped by a crown and surrounded by the motto *Honi soit qui mal y pense* ("Shame on he who thinks evil of it").

▼ **AT REST**
Now restored to its pre-Trafalgar condition, the *Victory* sits in dry dock at Portsmouth, England. It is the oldest ship in the world that is still officially in naval service.



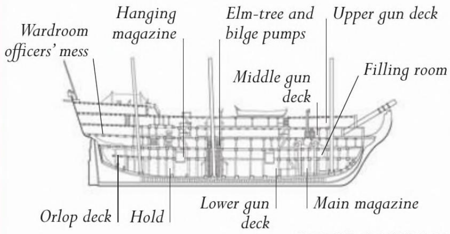
▲ **RIGGING BLOCK**
Ropes that raise, lower, and manipulate sails are known as running rigging. In total, the *Victory*'s rigging used 768 blocks, or pulleys.

▲ **PLATFORM**
The top – a platform halfway up each mast – was used by the crew to access the sails. In battle, seamen stood on the tops to fire down on the enemy.

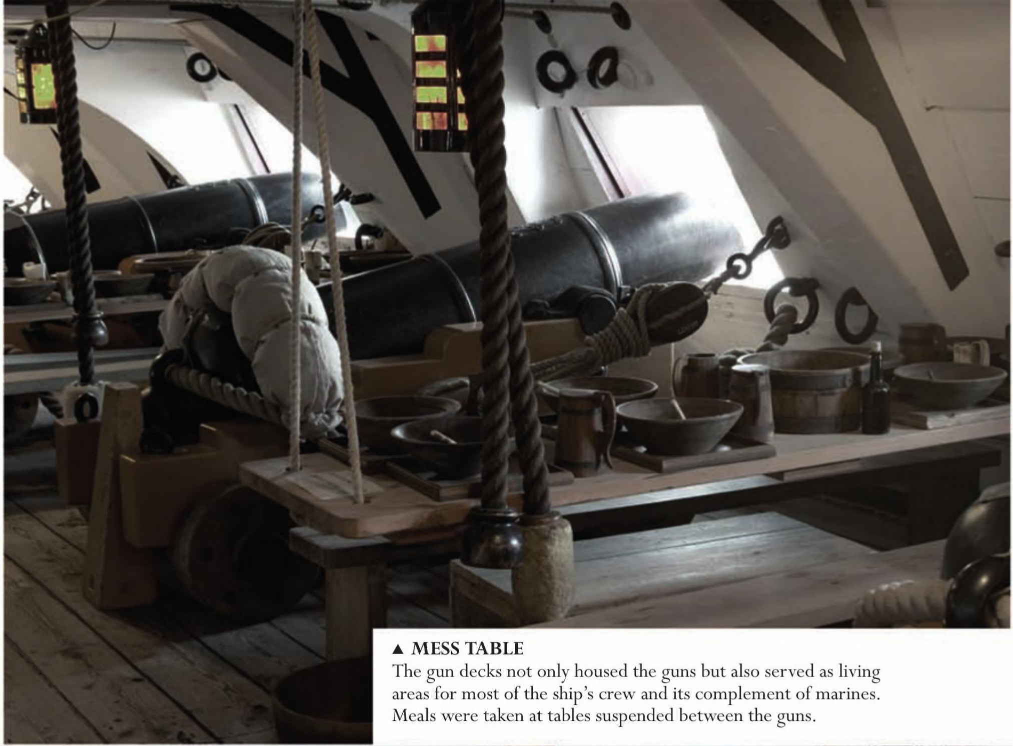
▲ **JEER BLOCKS**
One of the most complex areas of rigging is just below the top, where the lower yard is held in place using large pieces of wood called jeer blocks.

BELOW DECK

To keep the *Victory* stable, the heaviest guns – the 32-pounders – were positioned on the lower gun deck. The middle gun deck held the 24-pounders, while the 12-pounders were located on the upper gun deck. The orlop deck and hold, which were beneath the water line and safe from enemy fire, contained the magazines. The hold was also used for storage and ballast.

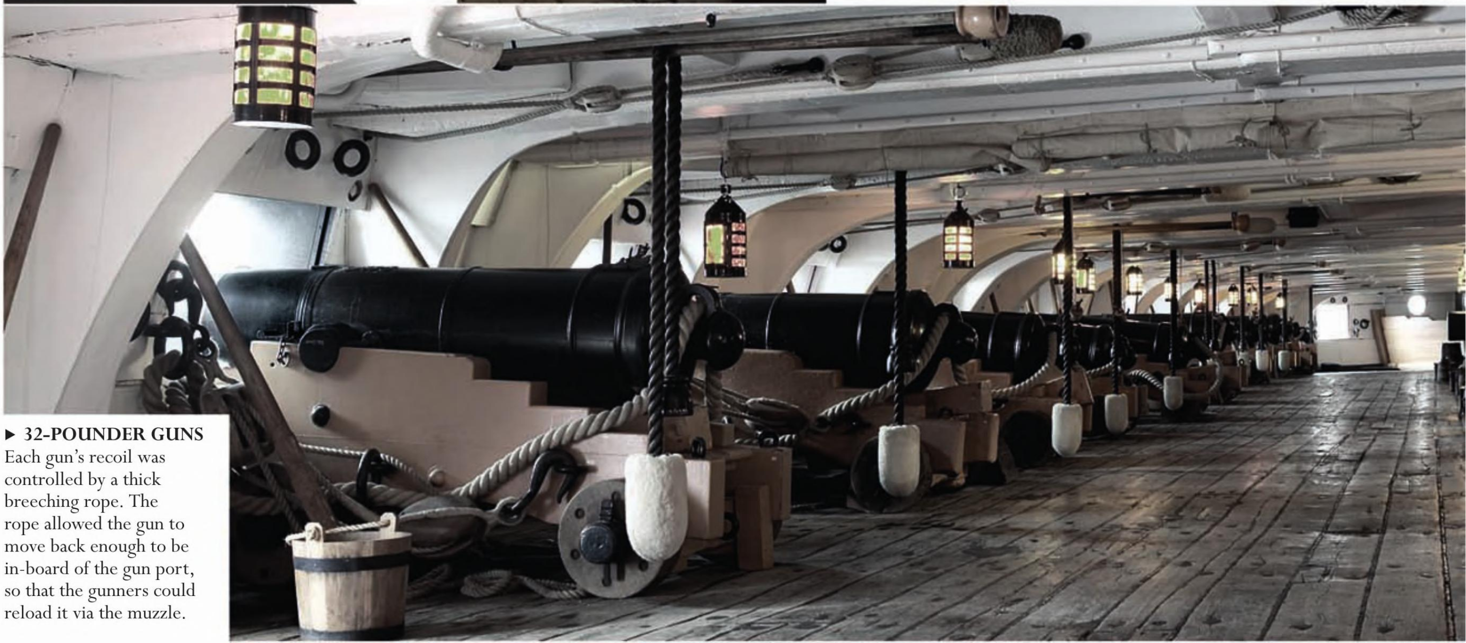

Wardroom officers' mess
Hanging magazine
Elm-tree and bilge pumps
Upper gun deck
Middle gun deck
Filling room
Orlop deck
Hold
Lower gun deck
Main magazine

CROSS-SECTION



▲ MESS TABLE
The gun decks not only housed the guns but also served as living areas for most of the ship's crew and its complement of marines. Meals were taken at tables suspended between the guns.

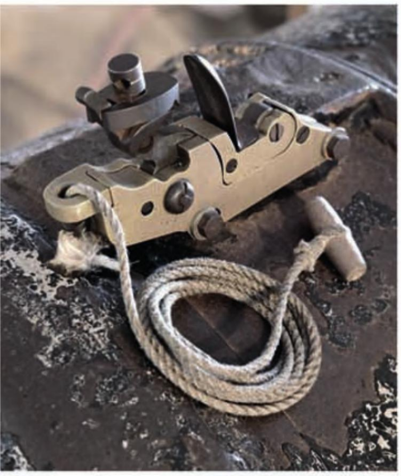
GUN DECKS



▶ 32-POUNDER GUNS
Each gun's recoil was controlled by a thick breeching rope. The rope allowed the gun to move back enough to be in-board of the gun port, so that the gunners could reload it via the muzzle.

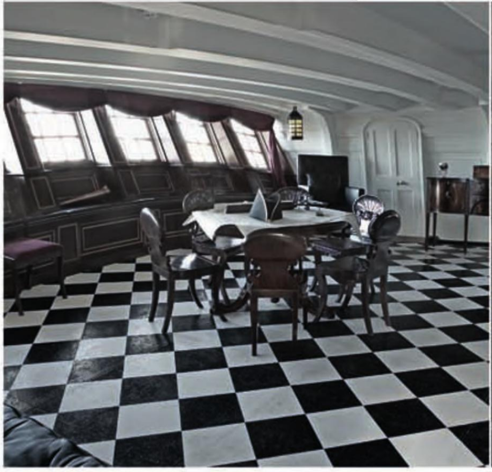
▶ ELM-TREE PUMP
Two pumps made from elm trunks drew water up from the sea to fight fires and wash down the decks. They were operated from beside the mainmast on the lower gun deck. The *Victory* also had four chain pumps to remove bilge water or pump out water if the hull became holed (damaged).

▲ SICK BERTH
Sick or injured men were moved to a small area near the bow on the upper gun deck. In battle, they were taken below to the orlop deck, enabling the sick berth to become a functioning part of the gun deck.

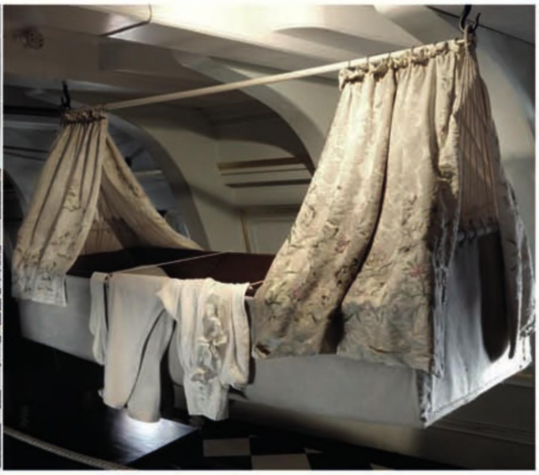


▲ FLINTLOCK
The guns had flintlocks. Pulling the cord made a flint strike a spark to fire the gun.

SENIOR OFFICERS' ROOMS



▲ CAPTAIN'S DAY CABIN
At the stern of the ship, the admiral and the captain both had light and spacious cabins that provided separate areas for sleeping, dining, and working.



▲ ADMIRAL'S COT
The admiral and other high-ranking officers slept in box-like cots that hung from the deckhead. An officer's cot would also serve as a coffin in the event of his death.

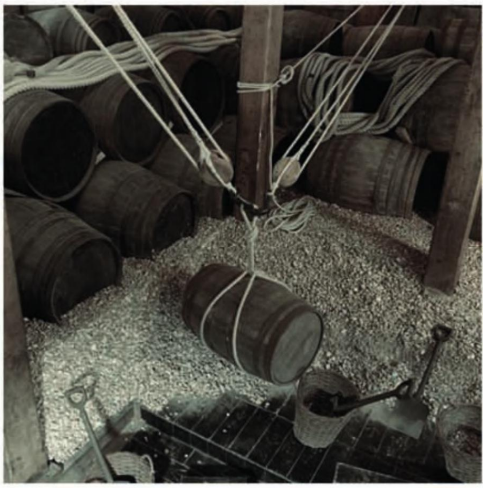
ORLOP DECK AND HOLD

▲ DISPENSARY
The surgeon's dispensary was located on the orlop deck. The cockpit, an open area nearby, acted as an operating theatre.

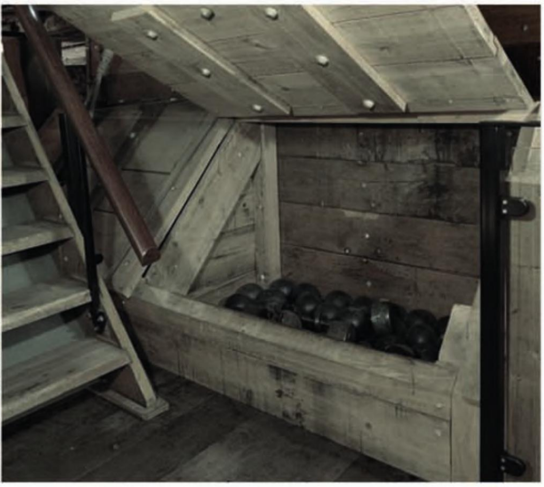
▲ BOSUN'S STOREROOM
The boatswain (bosun) was in charge of the deck crew. His store in the hold held supplies to repair the rigging.

▲ CHARGE RACKS
Gunpowder charges were made up in the filling room in the hold, and then stored on racks in magazines.

▲ HAMMOCKS
Most of the ship's men slept in hammocks slung from the beams of the gun deck.



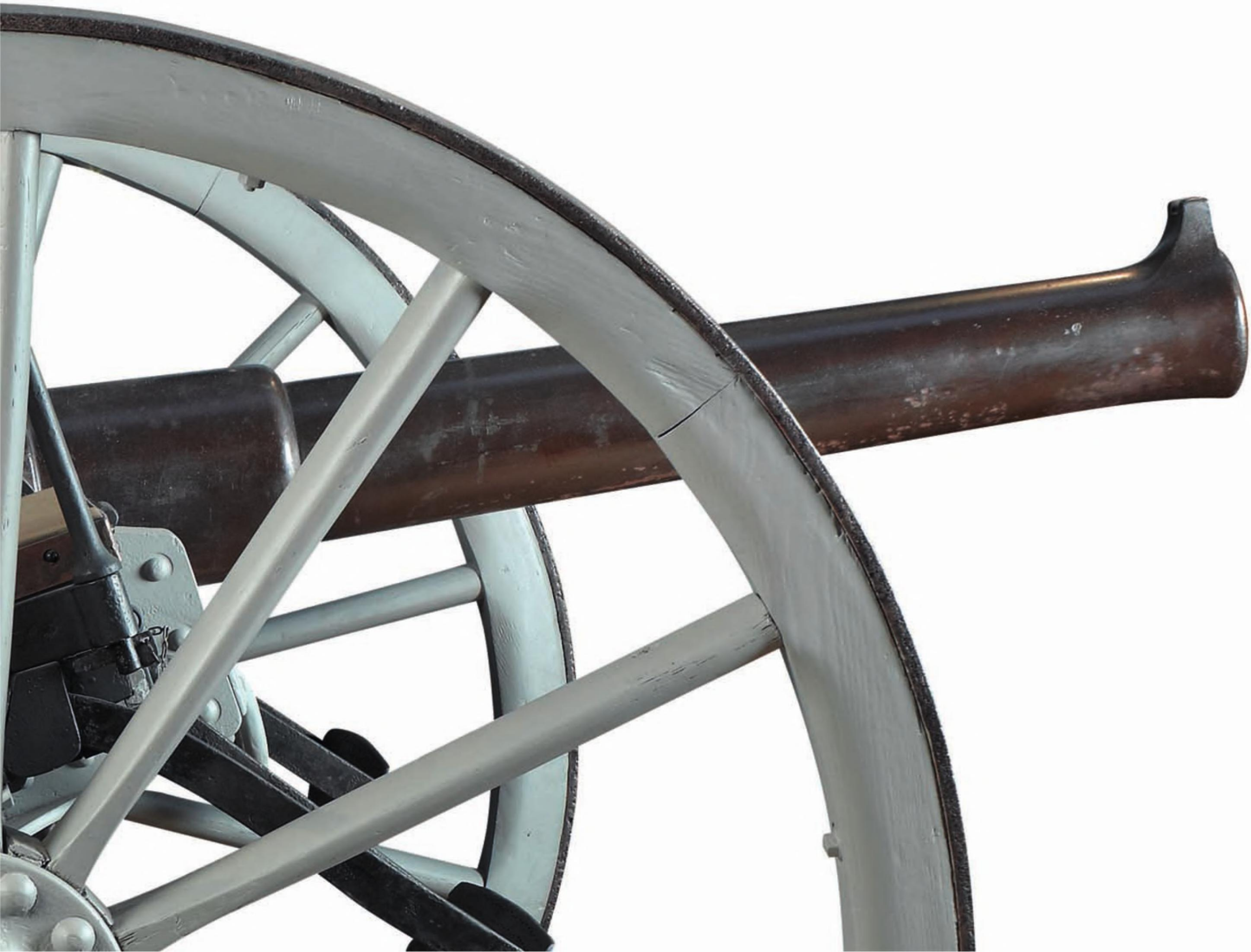
▲ BALLAST
On the floor of the hold lay 464 tonnes (457 tons) of ballast, which was needed to keep the ship level and upright. The ballast consisted of iron ingots and shingle.



▲ SHOT LOCKERS
Around 122 tonnes (120 tons) of cast-iron shot were kept in the hold. The largest shot weighed 14.5 kg (32lb). At Trafalgar, the *Victory* fired a total 27.5 tonnes (27 tons) of shot.

1815–1914

INDUSTRY AND IMPERIALISM



INTRODUCTION

Between 1815 and 1914, technological progress transformed conflict. High-explosive and rapid-fire mechanisms greatly increased the killing power of weaponry; railways enabled greater mobility; the telegraph, telephone, and radio revolutionized communications; and warfare spread into the skies and beneath the oceans.

Developments were relatively slow at first, but, in the 1830s, a forty-year transition period began, in which many hybrid and experimental technologies flourished. The long reign of the flintlock musket came to an end, though at first, mostly replaced by the rifle musket, which was still muzzle-loaded and slow-firing. Breech-loading rifles and pistols capable of repeated fire were invented, but armies were slow to accept them. At sea, ships used both steam engines and sails, and their wooden hulls were armoured with iron cladding. Even in the American Civil War of 1861–65, more soldiers still died of disease than in combat – as in wars of old.

The pace of change increased from the 1870s. The Franco-Prussian War of 1870–71 was fought by infantry with breech-loading rifles; the French fielded machine guns, while German rifled, breech-loading Krupp cannon bombarded Paris. In the 1880s, the use of smokeless propellants and high explosives in shells marked the end of the gunpowder era. New navies were built, with steel ships equipped with breech-loading rifled turret guns, as bolt-action repeater rifles became standard infantry equipment. Army organization was also changing, with the widespread adoption of the Prussian model of a professional general staff, and European powers committing to military service as a basic duty of their male citizens. More advanced nations amassed vast army and navy establishments, using them with success against tribal peoples and technologically inferior states, such as China or Turkey. The Russo-Japanese War of 1904–05 provided a glimpse of 20th-century conflict between industrialized states, with the presence of machine guns and heavy artillery, barbed wire, and trenches.

KEY **DATES**

1815

1816 Prussian military reforms lead to the creation of a permanent general staff

1827 The last fleet battle between sailing ships is fought at Navarino, Greece

1830s The French Navy introduces Paixhans guns, the first naval guns firing explosive shells

1835 Samuel Colt patents a cylinder revolver

1839–42 Steam gunboats help Britain defeat China in the Opium War

c.1840 Percussion caps begin to replace the flintlock firing mechanism in infantry weapons

1840s The use of the electronic telegraph becomes widespread, transforming long-distance military communication

1841 The breech-loading Dreyse needle gun is adopted by the Prussian army

1847 The invention of the Minié ball allows the introduction of rifle muskets

1853 Russian warships sink Turkish ships at Sinope, off the coast of Turkey, using explosive shells

1854–56 The horrors of the Crimean War stimulate progress in sanitation and care of the wounded

1859 France launches the first seagoing ironclad warship, *La Gloire*

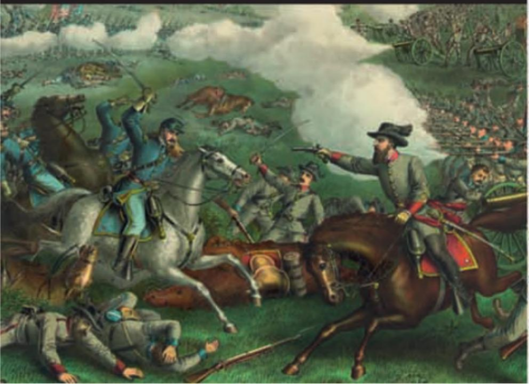
1859 France makes the first mass movement of troops by railway to fight the Austrians in Italy

1861–65 The American Civil War is fought

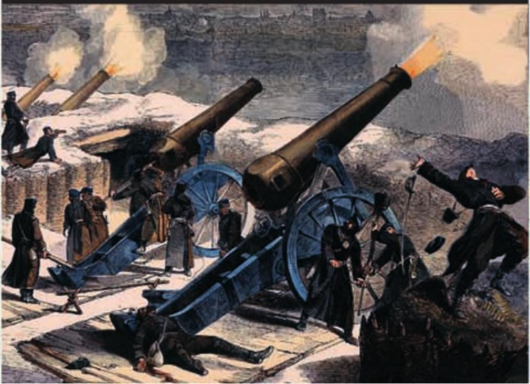
1862 The first battle between ironclad steam-powered warships is fought at Hampton Roads, Virginia

1862 The Battle of Antietam becomes the bloodiest day's fighting in American history

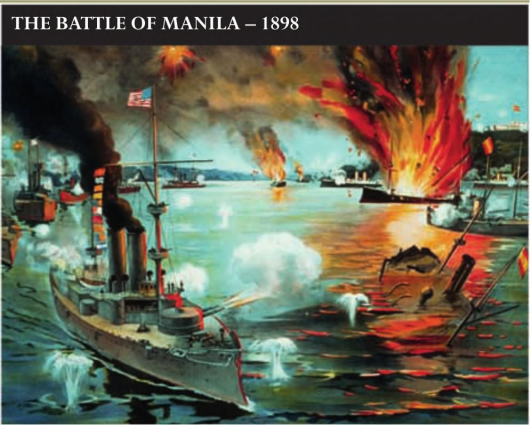
THE AMERICAN CIVIL WAR – 1861–1865



THE FRANCO-PRUSSIAN WAR – 1870–71



THE BATTLE OF MANILA – 1898



1866 The Gatling Gun, the forerunner of the machine-gun, is adopted by the US Army

1867 The Meiji Restoration begins in Japan, during which Japan modernizes its armed forces

1870–71 Prussia defeats France in the Franco-Prussian War

1871 The British Army adopts the single-shot, breech-loading, Martini-Henry rifle

1879 British soldiers defeat Zulus at the Battle of Rorke's Drift, in South Africa, aided by the Martini-Henry rifle

1880s Armies adopt bolt-action repeater rifles as their standard infantry weapon

1883 Hiram Maxim makes the first recoil-operated machine-gun

1886 A smokeless propellant replaces gunpowder

1897 France introduces the 75mm field gun, which is capable of firing 15 rounds per minute

1898 An Anglo-Egyptian army defeats the Sudanese Mahdists at Omdurman using Maxim guns

1899–1902 The Second Boer War is fought in southern Africa

c.1900 Submarines begin to enter service with the world's navies

1904–05 The Russo-Japanese War demonstrates new technology, including field telephones and barbed wire

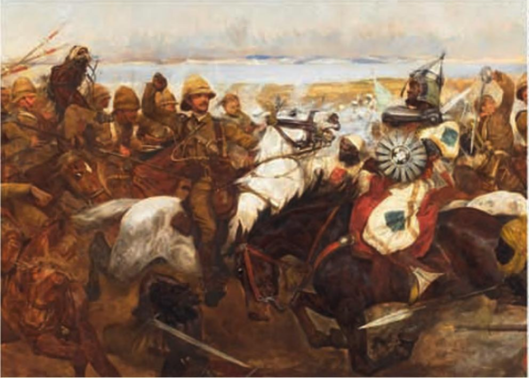
1905 The Imperial Japanese Navy defeats a Russian fleet at Tsushima, aided by the use of radio

1906 Britain launches the first Dreadnought-class battleship

1911 Italian aircraft drop bombs in a war against Turkey in Libya – the first use of aircraft in war

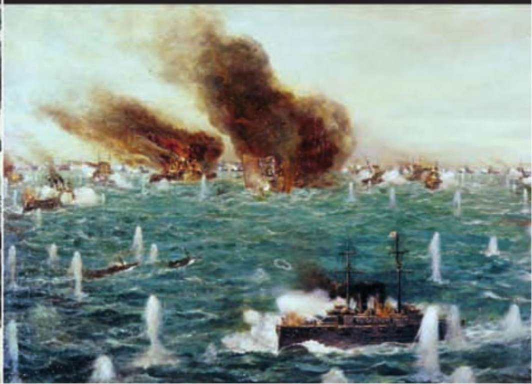
1914

THE BATTLE OF OMDURMAN – 1898



THE BOER WAR – 1880–1902

THE BATTLE OF TSUSHIMA – 1905

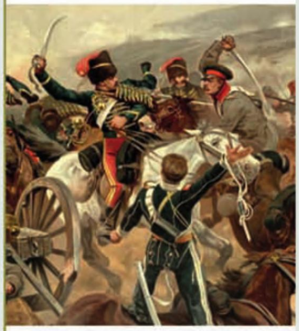


KEY **BATTLE**

CHARGE OF THE LIGHT BRIGADE

25 OCTOBER 1854

During the Crimean War, Lord Cardigan led an attack by British hussars, lancers, and dragoons on a heavy Russian artillery battery. Charging along a valley covered by dense Russian fire, the light cavalry lost almost half their number.



▲ The British horsemen reached the Russian guns, but at the cost of an excessive number of lives.

KEY DEVELOPMENT

THE BEGINNINGS OF MODERN WARFARE

In the 19th century, weaponry was transformed by the cumulative effect of technological innovations. Armies clung to well-established tactics, such as the cavalry charge and frontal infantry assault, but improved firepower made these methods increasingly obsolete.

The transformation of infantry weapons began in 1839, with the adoption of the percussion cap as an ignition system for muskets, over the long-established flintlock mechanism. However, in the 1840s, the Prussian army rearmed its infantry with the Dreyse needle gun, a bolt-action, breech-loading rifle firing a cartridge with integrated percussion cap, powder, and bullet. This had a higher rate of fire than muskets, and could be fired lying or kneeling behind cover.

In 1853, the British Army adopted the Enfield rifled musket, which fired the Minié ball: this ingenious bullet was small enough to be rammed down the barrel, but expanded when fired to engage the rifling. First used in the Crimean War (1854–56), fought between Russian and allied forces, the rifled musket had more than twice the range of a conventional musket, and it became the standard infantry weapon of the American Civil War (1861–65). It greatly increased the infantry casualties across open ground, even when they advanced in a loose skirmish line, rather than traditional columns.

▲ **THE COLT DRAGOON REVOLVER** Supplied to American mounted troops from 1848, the Colt Dragoon pistol had six revolving chambers. The soldier loaded each chamber with a ball, black powder, and a percussion cap.

TECHNOLOGICAL DEVELOPMENTS

In the Franco-Prussian War of 1870–71, infantry on both sides used breech-loading rifles firing the self-contained cartridge, an invention that led to repeater rifles, revolvers, and machine-guns: early rapid-fire weapons emerged in the 1860s, with the French Mitrailleuse and the American Gatling gun (see pp.246–47), although the first true machine-gun, the Maxim gun, came into service in the 1880s. Cavalry in the American Civil War often carried Colt or Remington revolvers and Spencer repeating carbines, but only a few infantry had repeating rifles.

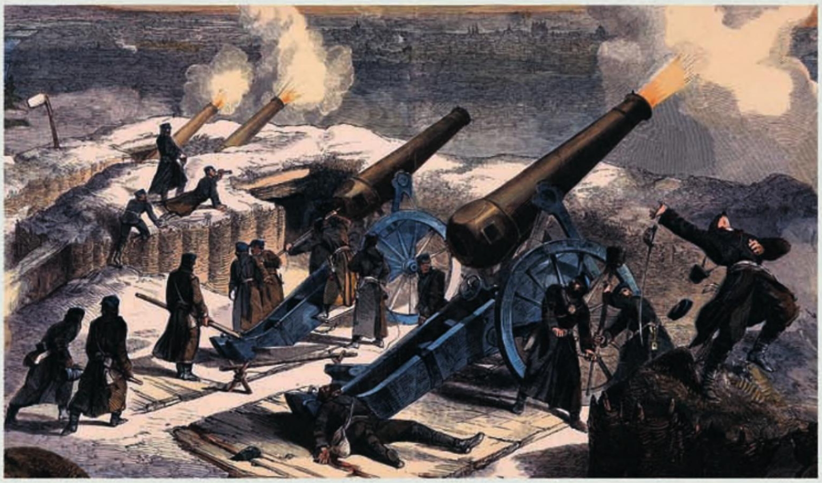
By the 1880s, advanced armies were adopting bolt-operated magazine rifles as standard, whereas innovations in artillery were slower. The American Civil War featured muzzle-loading, smoothbore cannon that were only a marginal improvement on

> “The fire **was so destructive** my line wavered like a **man trying to walk against [the] wind**”
>
> **CONFEDERATE COLONEL WILLIAM OATES**, WRITING ABOUT GETTYSBURG, 1905

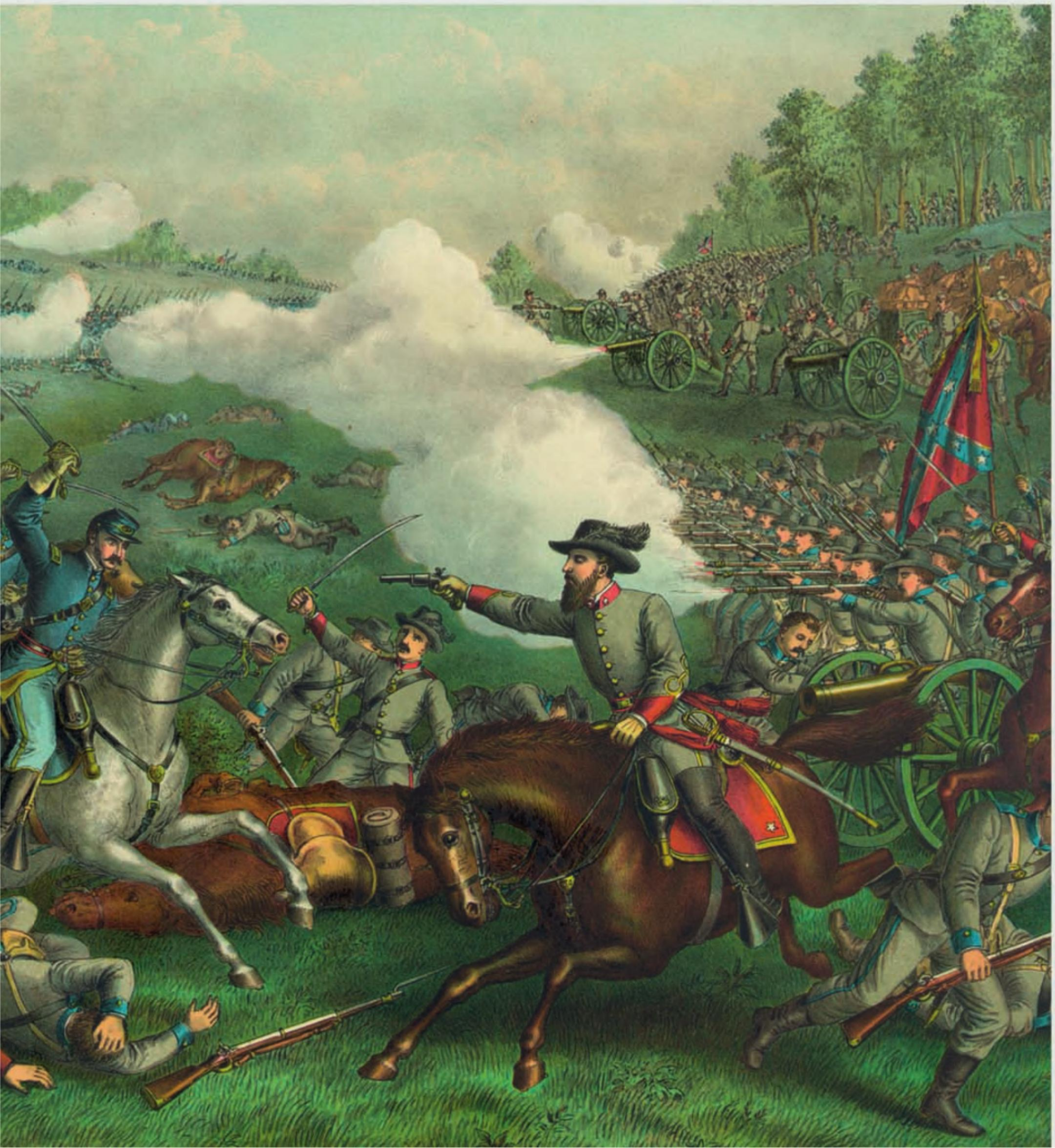
cannon of the Napoleonic era. However, from the 1870s, breech-loading, rifled artillery, pioneered by the Prussians, transformed both range and rate of fire. Firing high-explosive steel shells, the French 75 field gun, introduced in 1898, could fire up to 30 rounds a minute up to 8.5km (5 miles).

LOGISTICS AND COMMUNICATION

Military commanders were mostly quick to adopt new technology. Two of the most important influences on 19th-century warfare – railways and the electric telegraph – were civilian inventions. Large-scale military use of railways came in 1859, when the French moved over 100,000 soldiers by train to fight the Austrians in northern Italy; soon after, both the railway and the telegraph were to prove invaluable in the American Civil War.



▲ LONG-RANGE SIEGE GUNS
During the Franco-Prussian War of 1870–71, Paris was bombarded with heavy Krupp siege guns. The superior performance of these breech-loading cannon was a major factor in Prussia's victory in the war.



◄ CIVIL WAR CAVALRY
While cavalry still had an important role in the American Civil War, as in conflicts of old, the traditional charge with sabres drawn was increasingly rare, as the revolver and carbine proved their superiority.

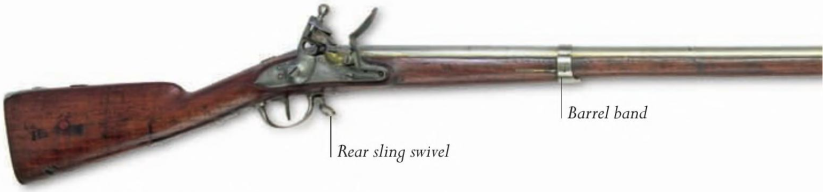
KEY **EVENTS**

19TH CENTURY

- **1854–56** The rifled musket is employed in the Crimean War, which also sees use of the electric telegraph, and the beginnings of war photography.
- **1863** At the Battle of Gettysburg, an assault by Confederate infantry – known as Pickett's Charge – fails, with 50 per cent casualties caused by the combined firepower of Union rifled muskets and cannon.
- **1866** Prussia defeats Austria in the Seven Weeks' War, helped by its efficiency in mobilizing its forces by rail, and its use of the breech-loading Dreyse needle gun.
- **1870–71** France is defeated in the Franco-Prussian War, chiefly because of the superiority of Prussian artillery.

FLINTLOCK MUSKETS AND BREECH-LOADING RIFLES

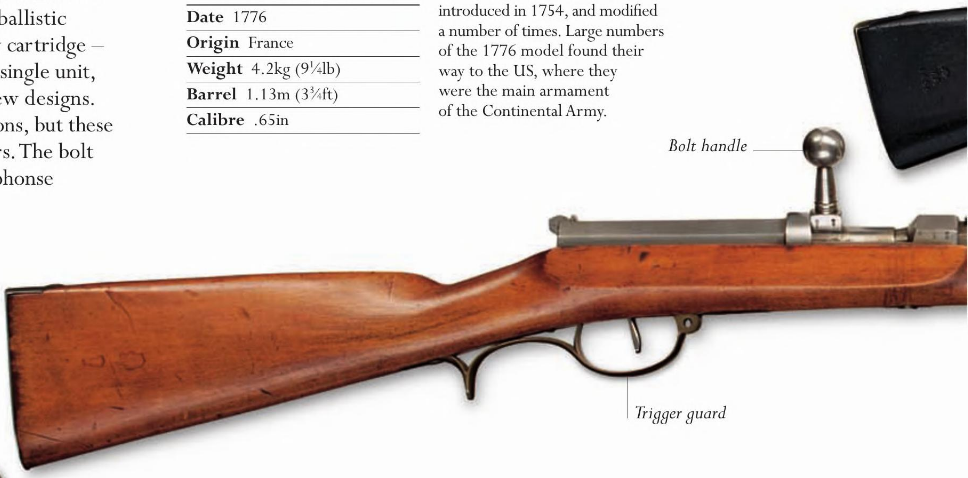
Muzzle-loading flintlock muskets, such as the French Charleville and the British "Brown Bess", proved reliable and robust. Thousands of these were made and remained in service until around 1840, by which time armed forces had recognized the ballistic advantages of rifled guns. The development of the unitary cartridge – which combined the bullet and ignition components in a single unit, and could be loaded by way of the breech – inspired new designs. Initially, many were conversions of muzzle-loading weapons, but these were followed by a range of purpose-built breech-loaders. The bolt action, pioneered by Johann von Dreyse and Antoine Alphonse Chassepot, was perfected by the Mauser brothers.


Barrel band
Rear sling swivel

▲ **CHARLEVILLE MUSKET**

Date	1776
Origin	France
Weight	4.2kg (9¼lb)
Barrel	1.13m (3¾ft)
Calibre	.65in

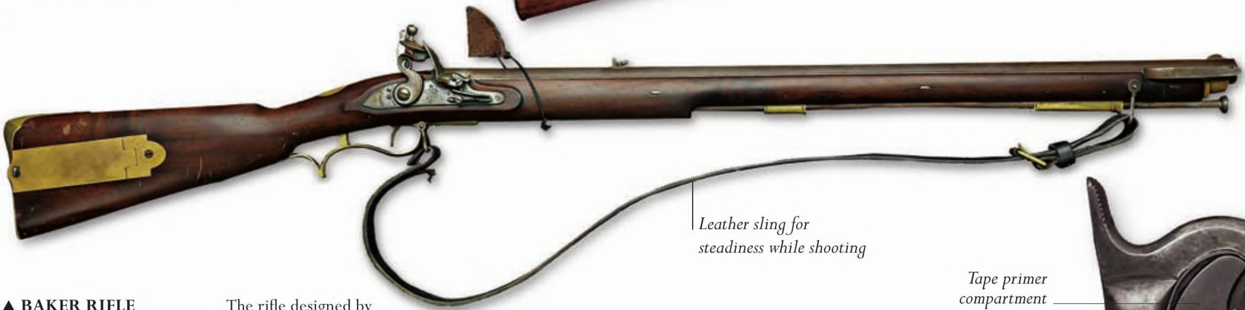
Charleville muskets were introduced in 1754, and modified a number of times. Large numbers of the 1776 model found their way to the US, where they were the main armament of the Continental Army.


Bolt handle
Trigger guard

▶ **DREYSE NEEDLE GUN MODEL 1841**

Date	1841
Origin	Prussia
Weight	4.5kg (10lb)
Barrel	70cm (28in)
Calibre	13.6mm

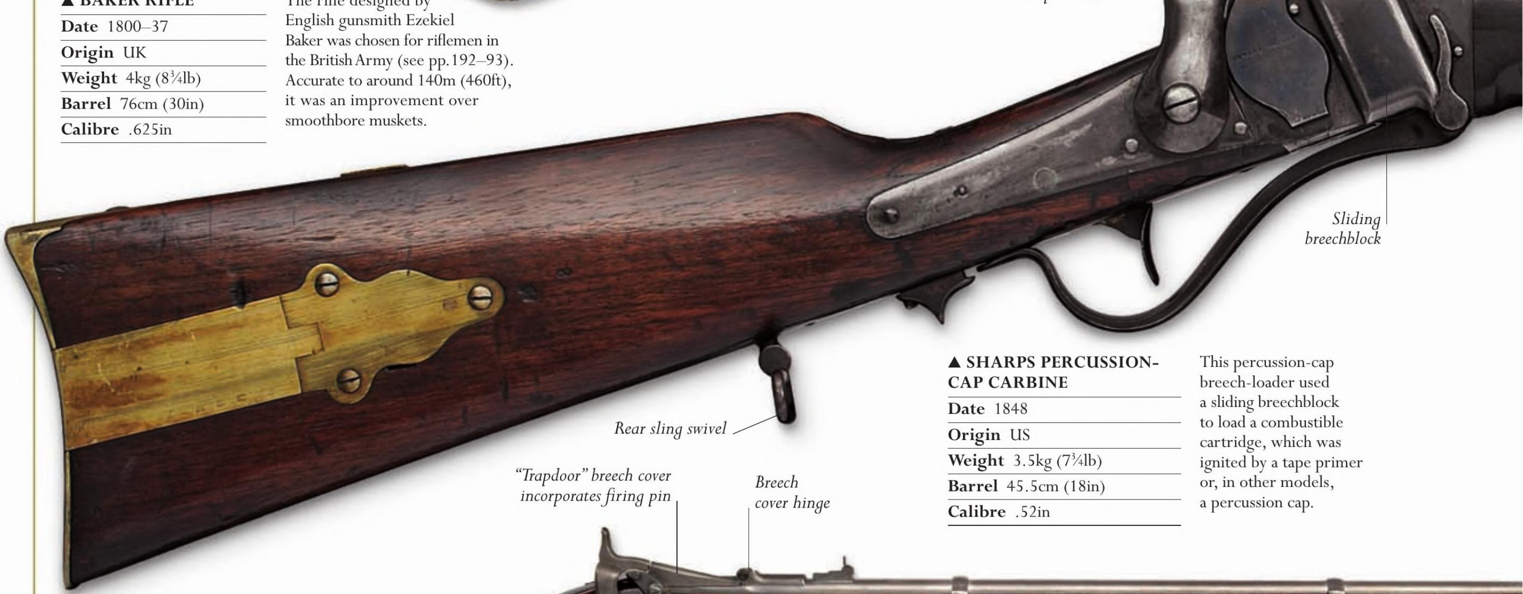
Dreyse's rifle had a simple straight-handed bolt, terminating in a needle that penetrated the length of a (linen) cartridge to detonate a percussion cap in the base of a Minié bullet.


Leather sling for steadiness while shooting

▲ **BAKER RIFLE**

Date	1800–37
Origin	UK
Weight	4kg (8¾lb)
Barrel	76cm (30in)
Calibre	.625in

The rifle designed by English gunsmith Ezekiel Baker was chosen for riflemen in the British Army (see pp.192–93). Accurate to around 140m (460ft), it was an improvement over smoothbore muskets.


Tape primer compartment
Sliding breechblock
Rear sling swivel

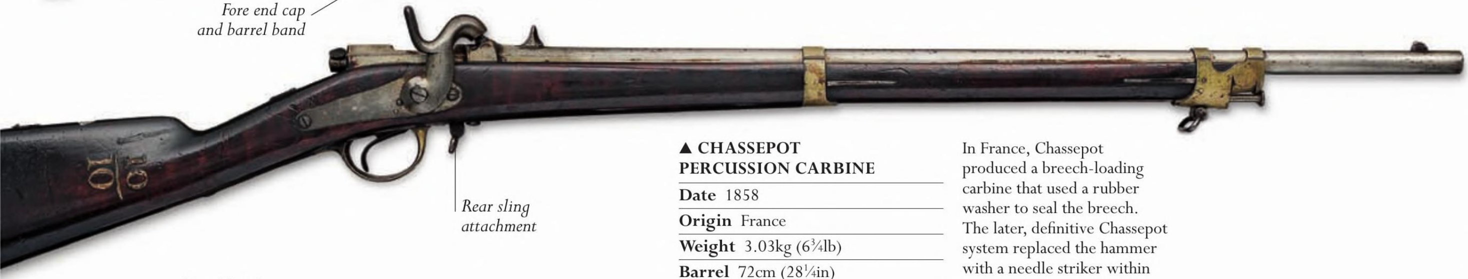
▲ **SHARPS PERCUSSION-CAP CARBINE**

Date	1848
Origin	US
Weight	3.5kg (7¾lb)
Barrel	45.5cm (18in)
Calibre	.52in

This percussion-cap breech-loader used a sliding breechblock to load a combustible cartridge, which was ignited by a tape primer or, in other models, a percussion cap.

"Trapdoor" breech cover incorporates firing pin
Breech cover hinge

Fore end cap and barrel band

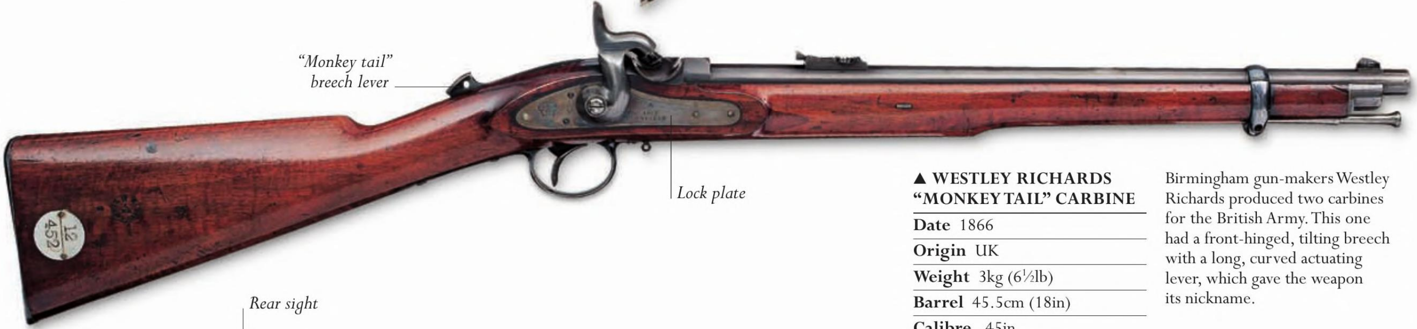

Rear sling attachment

▲ CHASSEPOT PERCUSSION CARBINE

Date	1858
Origin	France
Weight	3.03kg (6¾lb)
Barrel	72cm (28¼in)
Calibre	13.5mm

In France, Chassepot produced a breech-loading carbine that used a rubber washer to seal the breech. The later, definitive Chassepot system replaced the hammer with a needle striker within a turn-bolt.

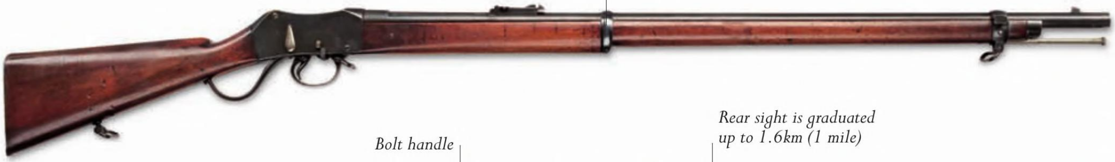
Barrel band retaining springs


"Monkey tail" breech lever
Lock plate

▲ WESTLEY RICHARDS "MONKEY TAIL" CARBINE

Date	1866
Origin	UK
Weight	3kg (6½lb)
Barrel	45.5cm (18in)
Calibre	.45in

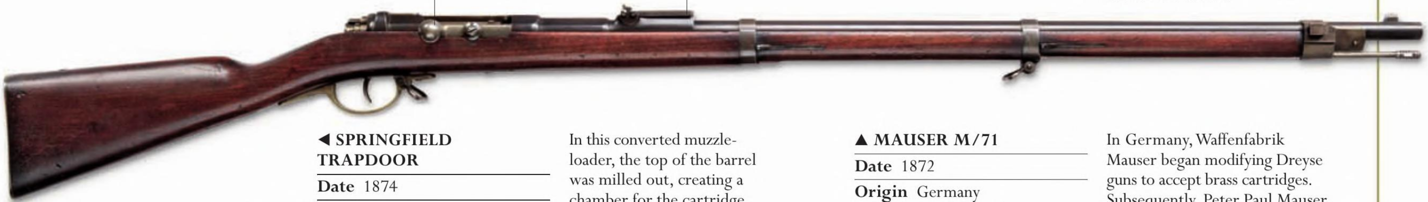
Birmingham gun-makers Westley Richards produced two carbines for the British Army. This one had a front-hinged, tilting breech with a long, curved actuating lever, which gave the weapon its nickname.


Barrel band anchoring the barrel in stock

◀ MARTINI-HENRY MK I

Date	1871
Origin	UK
Weight	4.7kg (10¼lb)
Barrel	85cm (33½in)
Calibre	.45 Martini

The British Army's first purpose-designed, breech-loading rifle, the Martini-Henry incorporated a tilting breech block. Lowering the under-lever opened the breech and cocked the action.


Bolt handle
Rear sight is graduated up to 1.6km (1 mile)

◀ SPRINGFIELD TRAPDOOR

Date	1874
Origin	US
Weight	4.5kg (10lb)
Barrel	82.5cm (32½in)
Calibre	.45in

In this converted muzzle-loader, the top of the barrel was milled out, creating a chamber for the cartridge, while the front-hinged breech cover incorporated a firing pin.

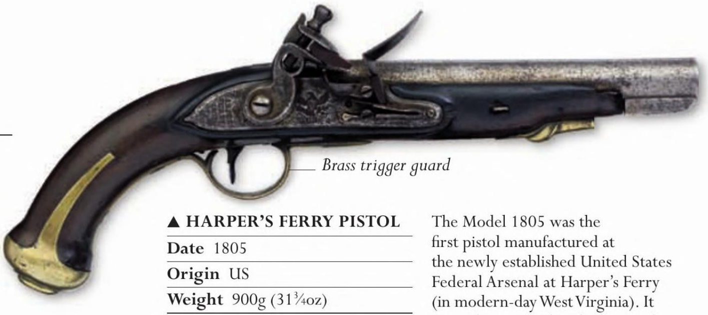
▲ MAUSER M/71

Date	1872
Origin	Germany
Weight	4.5kg (10lb)
Barrel	83cm (32½in)
Calibre	11mm × 60R

In Germany, Waffenfabrik Mauser began modifying Dreyse guns to accept brass cartridges. Subsequently, Peter Paul Mauser produced this new design, which was strong enough to handle much more powerful ammunition.

FLINTLOCK AND PERCUSSION PISTOLS AND EARLY REVOLVERS

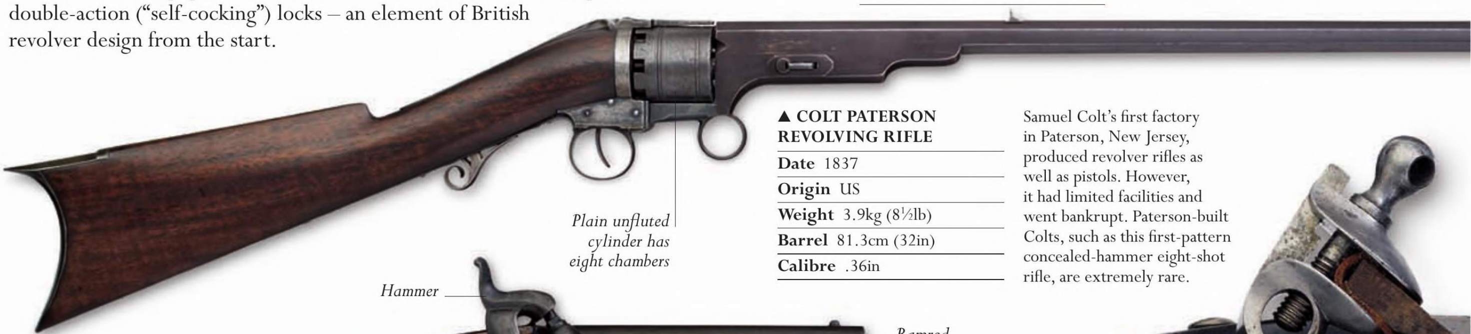
American Samuel Colt patented the design of a new type of pistol in 1835 – a six-shot cylinder revolver that fired percussion-cap ammunition. Colt was the first manufacturer to prove that it was commercially viable to mass-produce revolvers – no fewer than 215,348 of his .36 calibre Model 1851 revolver were sold from 1851 to 1876. British interest in pistols was sparked by Colt's display at the Great Exhibition of 1851 in London. By the end of the 1850s, revolvers made by London gunmakers such as Robert Adams had become more popular in Britain than American Colts. Adams's pistols had double-action ("self-cocking") locks – an element of British revolver design from the start.



▲ HARPER'S FERRY PISTOL

Date 1805
Origin US
Weight 900g (31¾oz)
Barrel 25.4cm (10in)
Calibre .54in

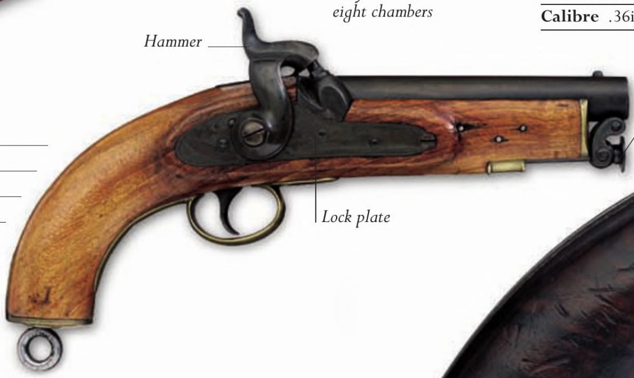
The Model 1805 was the first pistol manufactured at the newly established United States Federal Arsenal at Harper's Ferry (in modern-day West Virginia). It was robust enough to be reversed and used as a club if required.



▲ COLT PATERSON REVOLVING RIFLE

Date 1837
Origin US
Weight 3.9kg (8½lb)
Barrel 81.3cm (32in)
Calibre .36in

Samuel Colt's first factory in Paterson, New Jersey, produced revolver rifles as well as pistols. However, it had limited facilities and went bankrupt. Paterson-built Colts, such as this first-pattern concealed-hammer eight-shot rifle, are extremely rare.

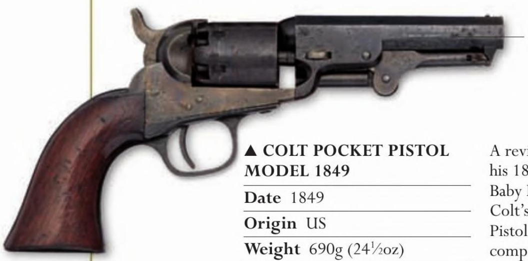


► PATTERN 1842 COAST GUARD PISTOL

Date 1842
Origin UK
Weight 1.05kg (2¼lb)
Barrel 15cm (6in)
Calibre 24-bore

In the 1842 coast guard pistol, the ramrod retainer swivelled to allow the captive rod to be inserted in the barrel. These pistols were replaced by revolvers from the 1850s.

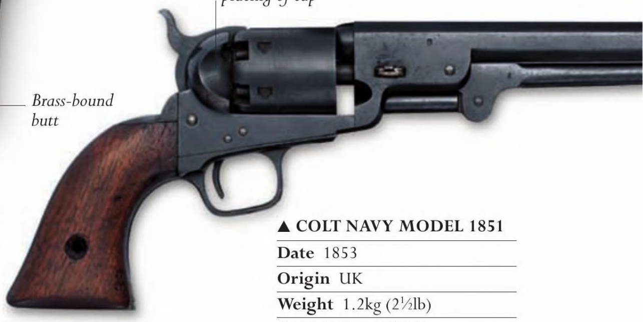
TOMAS
1841
Brass trigger guard
Brass-bound butt



▲ COLT POCKET PISTOL MODEL 1849

Date 1849
Origin US
Weight 690g (24½oz)
Barrel 10.2cm (4in)
Calibre .31in

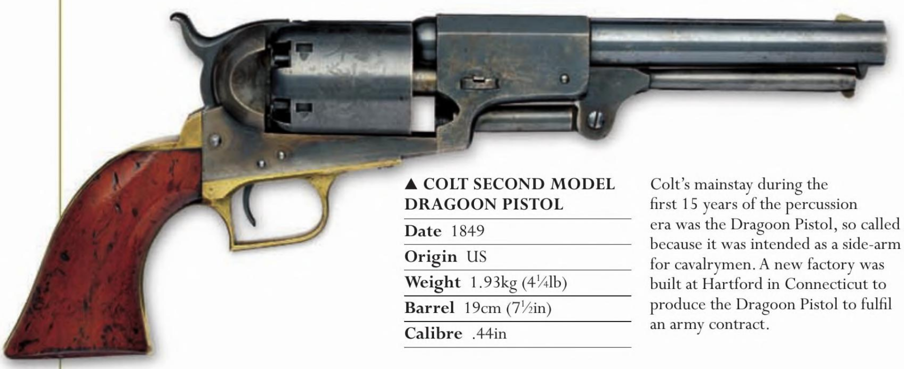
A revised version of his 1848 revolver, the Baby Dragoon, Samuel Colt's 1849 Pocket Pistol had a standard compound rammer, the choice of three barrel lengths, and a five- or six-shot cylinder.



▲ COLT NAVY MODEL 1851

Date 1853
Origin UK
Weight 1.2kg (2½lb)
Barrel 19cm (7½in)
Calibre .36in

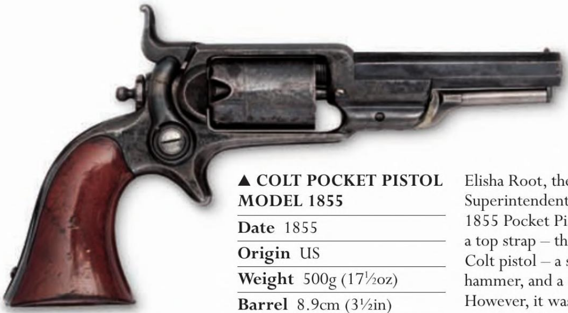
At the Great Exhibition of 1851 in London, Samuel Colt introduced the Navy Model, a lighter pistol in .36in rather than .44in calibre. After the display, he obtained an order from the British government. This is one of the pistols produced at the company's London factory.



▲ COLT SECOND MODEL DRAGOON PISTOL

Date 1849
Origin US
Weight 1.93kg (4¼lb)
Barrel 19cm (7½in)
Calibre .44in

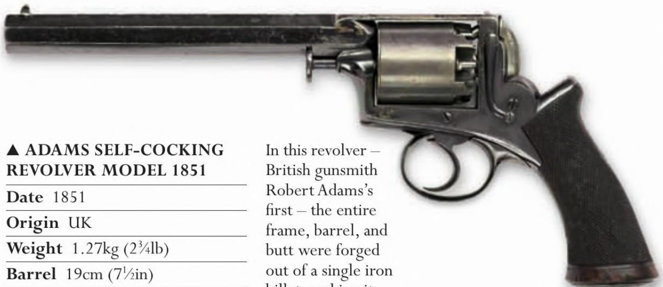
Colt's mainstay during the first 15 years of the percussion era was the Dragoon Pistol, so called because it was intended as a side-arm for cavalrymen. A new factory was built at Hartford in Connecticut to produce the Dragoon Pistol to fulfil an army contract.



▲ COLT POCKET PISTOL MODEL 1855

Date	1855
Origin	US
Weight	500g (17½oz)
Barrel	8.9cm (3½in)
Calibre	.28in

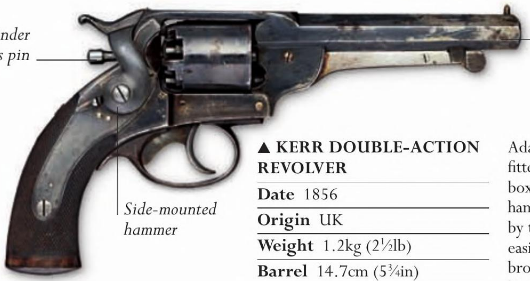
Elisha Root, the Colt Works Superintendent, designed the 1855 Pocket Pistol. It had a top strap – the first in a Colt pistol – a side-mounted hammer, and a stud trigger. However, it was not very popular and was discontinued in 1870.



▲ ADAMS SELF-COCKING REVOLVER MODEL 1851

Date	1851
Origin	UK
Weight	1.27kg (2¾lb)
Barrel	19cm (7½in)
Calibre	40-bore

In this revolver – British gunsmith Robert Adams's first – the entire frame, barrel, and butt were forged out of a single iron billet, making it extremely strong.



▲ KERR DOUBLE-ACTION REVOLVER

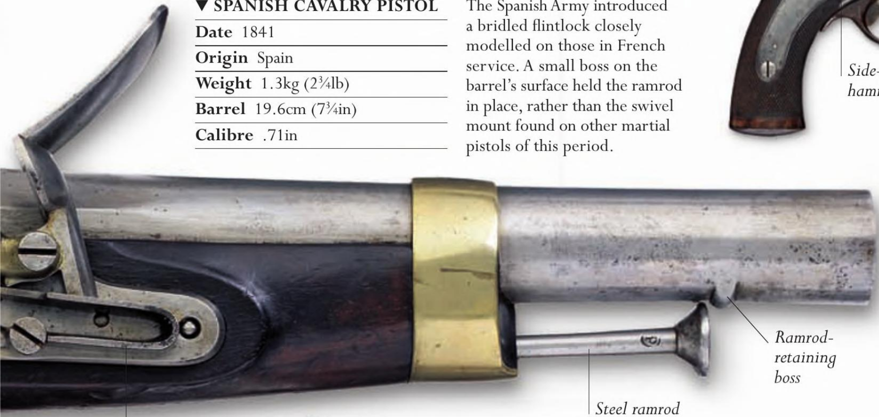
Date	1856
Origin	UK
Weight	1.2kg (2½lb)
Barrel	14.7cm (5¾in)
Calibre	54-bore

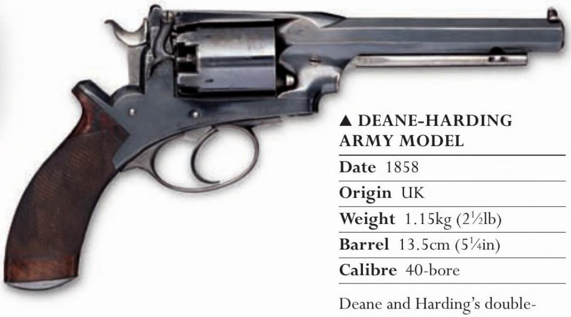
Adams's cousin James Kerr fitted his revolver with a simple box-lock and a side-mounted hammer. The lock was retained by two screws, and could be easily removed. If a component broke, any gunsmith would have been able to repair it.

▼ SPANISH CAVALRY PISTOL

Date	1841
Origin	Spain
Weight	1.3kg (2¾lb)
Barrel	19.6cm (7¾in)
Calibre	.71in

The Spanish Army introduced a bridled flintlock closely modelled on those in French service. A small boss on the barrel's surface held the ramrod in place, rather than the swivel mount found on other martial pistols of this period.

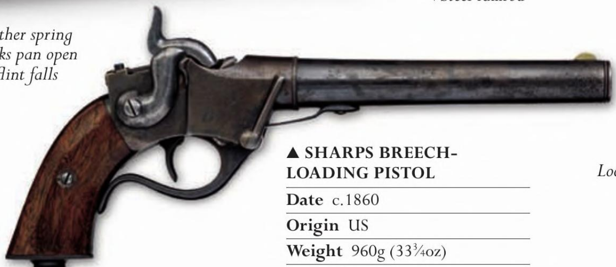




▲ DEANE-HARDING ARMY MODEL

Date	1858
Origin	UK
Weight	1.15kg (2½lb)
Barrel	13.5cm (5¼in)
Calibre	40-bore

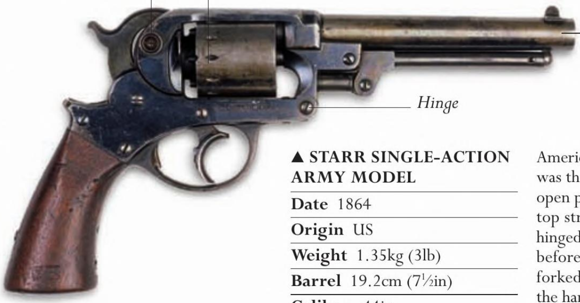
Deane and Harding's double-action lock was the forerunner of modern actions. In a double-action pistol, pulling the trigger cocks and then releases the action.



▲ SHARPS BREECH-LOADING PISTOL

Date	c.1860
Origin	US
Weight	960g (33¾oz)
Barrel	12.7cm (5in)
Calibre	.34in

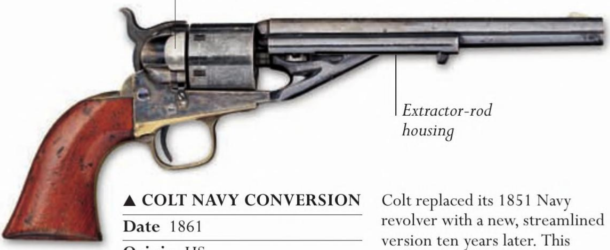
American inventor Christian Sharps was famous for his breech-loading rifles and carbines. He also made pistols based on the same principles of his early rifles.



▲ STARR SINGLE-ACTION ARMY MODEL

Date	1864
Origin	US
Weight	1.35kg (3lb)
Barrel	19.2cm (7½in)
Calibre	.44in

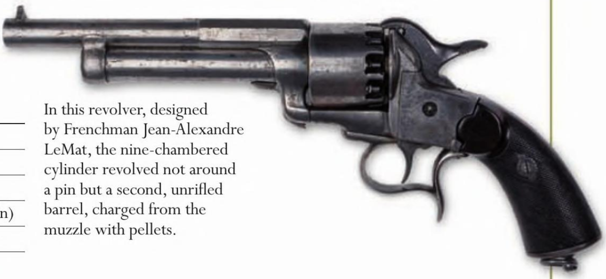
American gunmaker Nathan Starr was the pioneer of the break-open pistol, in which the barrel, top strap, and cylinder were hinged at the front of the frame before the trigger guard. The forked top strap passed over the hammer and was retained by a knurled screw.



▲ COLT NAVY CONVERSION

Date	1861
Origin	US
Weight	1.25kg (2¾lb)
Barrel	19cm (7½in)
Calibre	.36in

Colt replaced its 1851 Navy revolver with a new, streamlined version ten years later. This revolver has been converted to accept brass cartridges. Many percussion revolvers were adapted in this way.



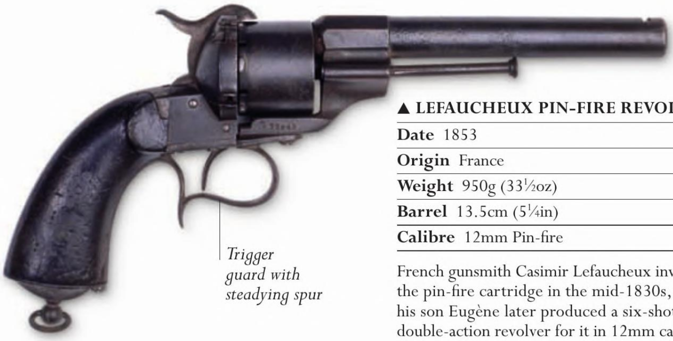
▶ LEMAT PISTOL

Date	1864
Origin	France
Weight	1.64kg (3½lb)
Barrel	Lower 12.7cm (5in)
Calibre	.3in and 16-bore

In this revolver, designed by Frenchman Jean-Alexandre LeMat, the nine-chambered cylinder revolved not around a pin but a second, unrifled barrel, charged from the muzzle with pellets.

METALLIC-CARTRIDGE PISTOLS

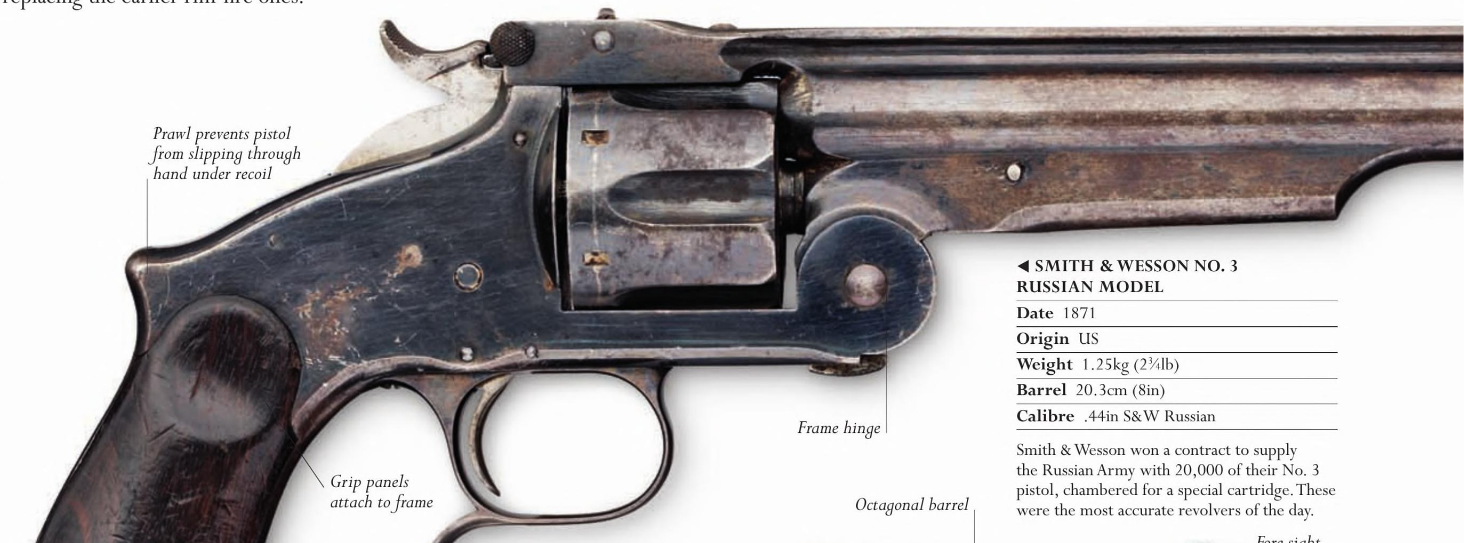
After the Colt percussion-cap revolvers, the next major breakthrough in pistol design was the Smith & Wesson Model 1, produced in 1857. Horace Smith and Daniel Wesson had purchased a patent from gunsmith Rollin White for a revolver in which the chambers were bored through the full length of the cylinder, which made breech-loading possible. This design was combined with their .22in rim-fire brass cartridge to enable fast reloading, which transformed the use of handguns. Smith & Wesson won important international orders for their No. 3 Model in 1871, by which time more powerful centre-fire cartridges were replacing the earlier rim-fire ones.


Trigger guard with steadying spur

▲ LEFAUCHEUX PIN-FIRE REVOLVER

Date	1853
Origin	France
Weight	950g (33½oz)
Barrel	13.5cm (5¼in)
Calibre	12mm Pin-fire

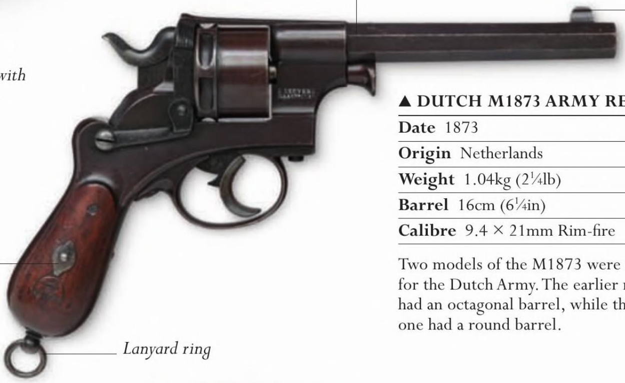
French gunsmith Casimir Lefaucheux invented the pin-fire cartridge in the mid-1830s, and his son Eugène later produced a six-shot, double-action revolver for it in 12mm calibre. This is a cavalry model.


Prawl prevents pistol from slipping through hand under recoil
Grip panels attach to frame
Butt-retaining screw
Trigger guard with steadying spur
Frame hinge

◀ SMITH & WESSON NO. 3 RUSSIAN MODEL

Date	1871
Origin	US
Weight	1.25kg (2¾lb)
Barrel	20.3cm (8in)
Calibre	.44in S&W Russian

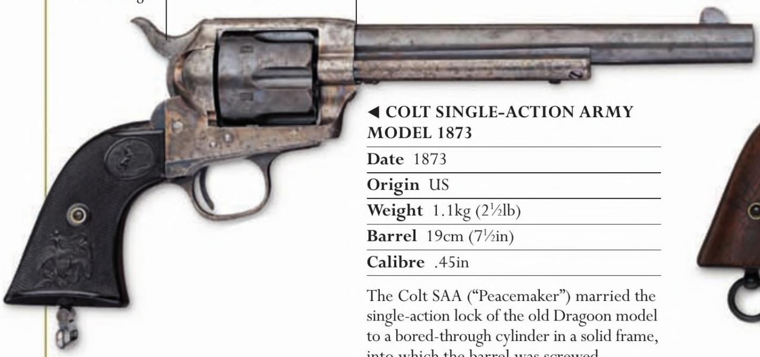
Smith & Wesson won a contract to supply the Russian Army with 20,000 of their No. 3 pistol, chambered for a special cartridge. These were the most accurate revolvers of the day.


Octagonal barrel
Fore sight
Grip screw
Lanyard ring

▲ DUTCH M1873 ARMY REVOLVER

Date	1873
Origin	Netherlands
Weight	1.04kg (2¼lb)
Barrel	16cm (6¼in)
Calibre	9.4 × 21mm Rim-fire

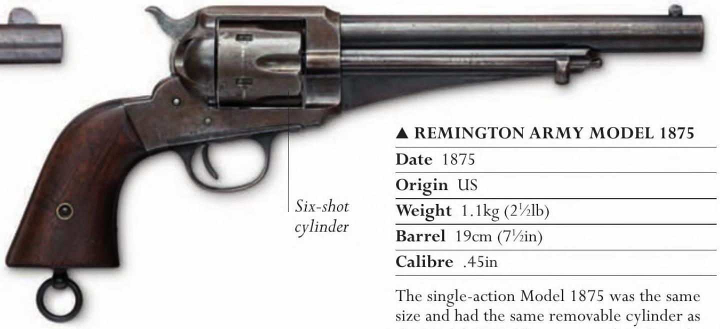
Two models of the M1873 were made for the Dutch Army. The earlier model had an octagonal barrel, while the later one had a round barrel.


Notched hammer acts as rear sight
Barrel screws into frame

◀ COLT SINGLE-ACTION ARMY MODEL 1873

Date	1873
Origin	US
Weight	1.1kg (2½lb)
Barrel	19cm (7½in)
Calibre	.45in

The Colt SAA ("Peacemaker") married the single-action lock of the old Dragoon model to a bored-through cylinder in a solid frame, into which the barrel was screwed.


Six-shot cylinder

▲ REMINGTON ARMY MODEL 1875

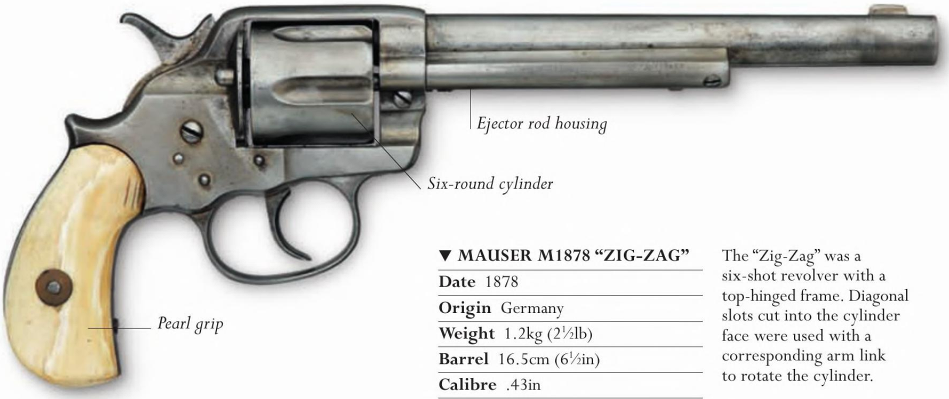
Date	1875
Origin	US
Weight	1.1kg (2½lb)
Barrel	19cm (7½in)
Calibre	.45in

The single-action Model 1875 was the same size and had the same removable cylinder as the Model 1858. The gun was also adapted for .40in and .44in cartridges.

▶ COLT FRONTIER DOUBLE-ACTION

Date 1878
Origin US
Weight 1kg (2¼lb)
Barrel 14cm (5½in)
Calibre .44/.45in

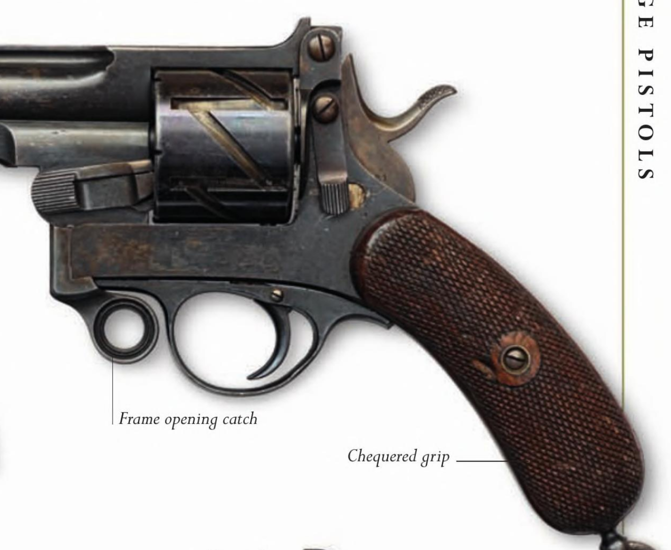
Colt produced its first double-action pistol, the Lightning, in 1877, and the following year produced this double-action version equivalent of the SAA "Peacemaker" in .44 and .45 calibres.


Ejector rod housing
Six-round cylinder
Pearl grip

▼ MAUSER M1878 "ZIG-ZAG"

Date 1878
Origin Germany
Weight 1.2kg (2½lb)
Barrel 16.5cm (6½in)
Calibre .43in

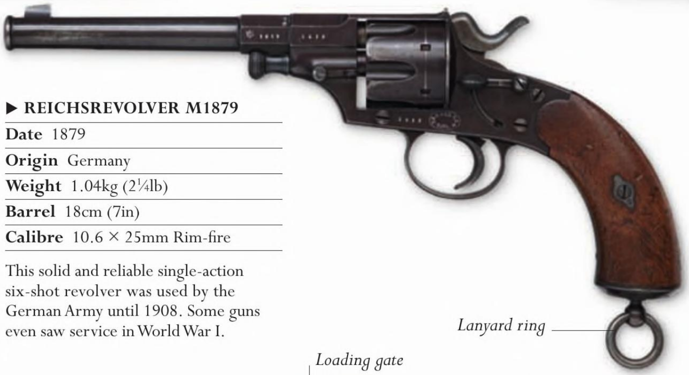
The "Zig-Zag" was a six-shot revolver with a top-hinged frame. Diagonal slots cut into the cylinder face were used with a corresponding arm link to rotate the cylinder.

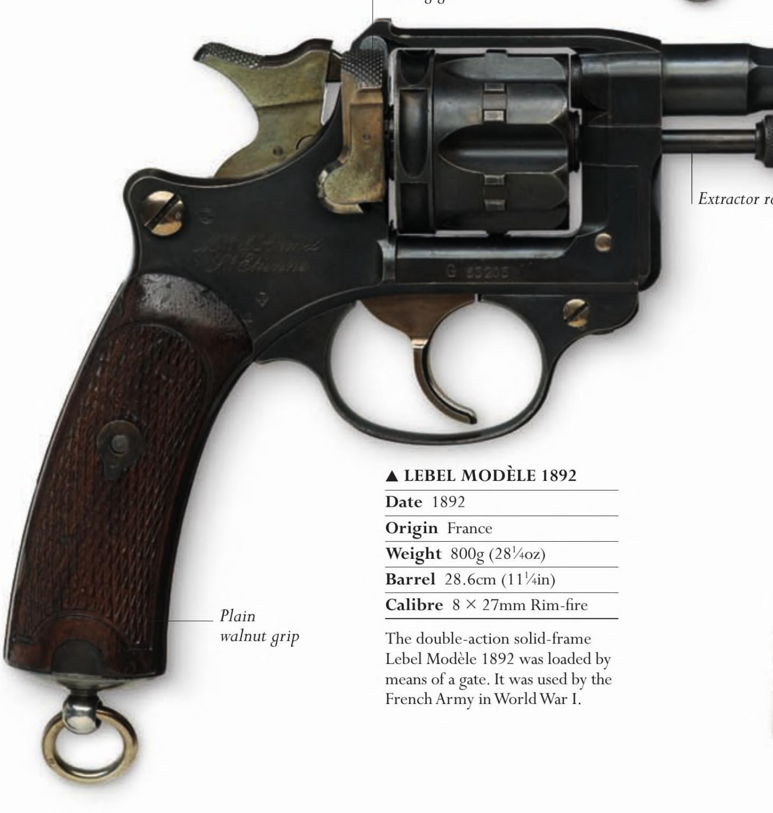

Frame opening catch
Chequered grip

▶ REICHSREVOLVER M1879

Date 1879
Origin Germany
Weight 1.04kg (2¼lb)
Barrel 18cm (7in)
Calibre 10.6 × 25mm Rim-fire

This solid and reliable single-action six-shot revolver was used by the German Army until 1908. Some guns even saw service in World War I.


Lanyard ring


Loading gate
Fore sight
Extractor rod
Plain walnut grip

▲ LEBEL MODÈLE 1892

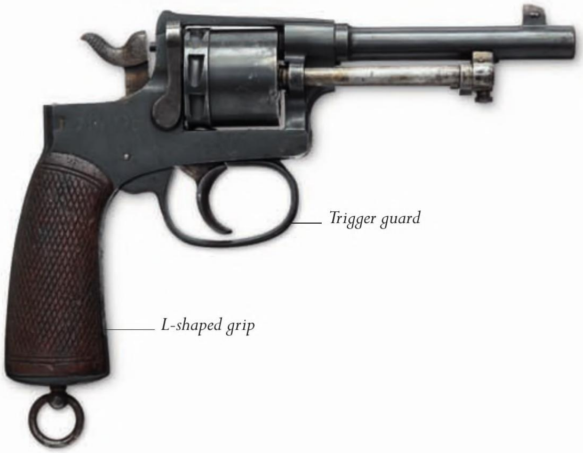
Date 1892
Origin France
Weight 800g (28¼oz)
Barrel 28.6cm (11¼in)
Calibre 8 × 27mm Rim-fire

The double-action solid-frame Lebel Modèle 1892 was loaded by means of a gate. It was used by the French Army in World War I.

▼ RAST AND GASSER M1898

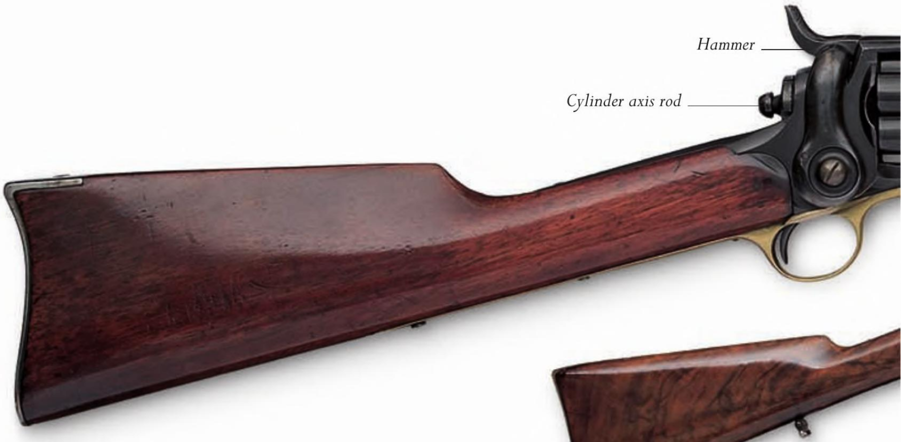
Date 1898
Origin Austria
Weight 930g (33oz)
Barrel 22.3cm (8¾in)
Calibre .32in

This reliable, solid-frame double-action pistol was issued to soldiers in the Austro-Hungarian Army in World War I. Around 200,000 of them were manufactured from 1898 to 1912.


Trigger guard
L-shaped grip

EARLY REPEATING RIFLES

The development of the unitary cartridge in the mid-19th century paved the way for the "repeater" rifle. This new weapon fed ammunition from a magazine to the breech as part of a single action that emptied the used cartridge case from the chamber, cocked the action, and readied the gun to fire. The first repeaters were mostly American, and used an under-lever design. Europeans, however, were familiar with the bolt action from single-shot Mauser and von Dreyse rifles of the 1870s, and came to prefer it in repeating guns. They considered the bolt action not only easier to use in a prone position, but also safer – because when the bolt was turned, the action was locked by lugs connecting with other parts in the receiver.



▼ SPENCER RIFLE

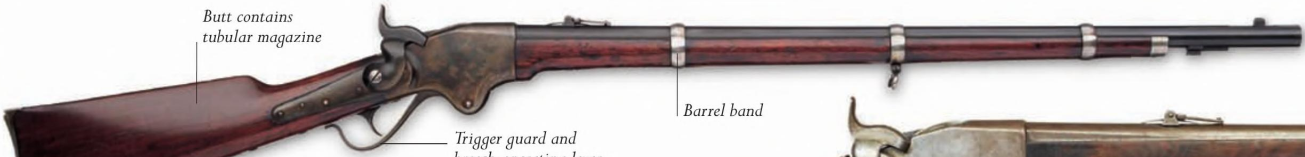
Date	1863
Origin	US
Weight	4.55kg (10lb)
Barrel	72cm (28¼in)
Calibre	.52in

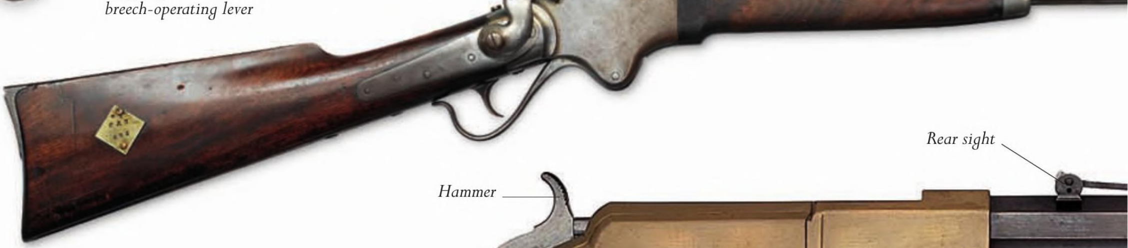
The Spencer, which had a tubular seven-round magazine in the butt stock, was the world's first practical military repeater. It was adopted by the Union Army in the American Civil War.

▲ COLT REVOLVING RIFLE MODEL 1855

Date	1855
Origin	US
Weight	3.45kg (7½lb)
Barrel	68.2cm (26¾in)
Calibre	.56in

The 1855 was the third model of the Colt Manufacturing Company's 1838 revolving rifle. It made a considerable impact, even though the loading procedure of the five-chambered cylinder was cumbersome.

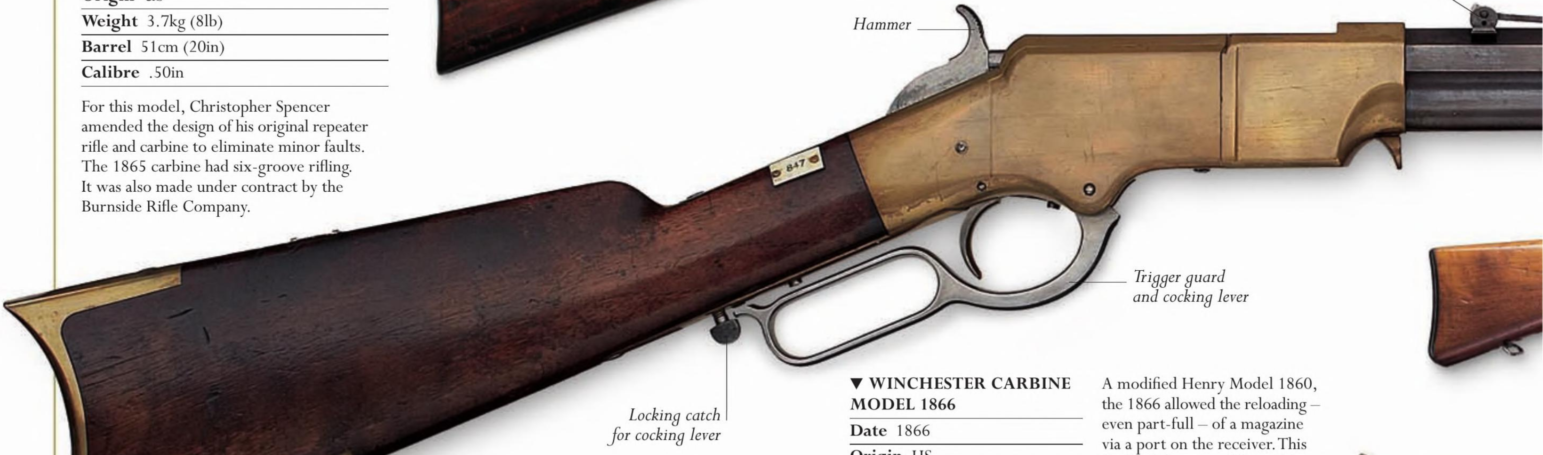

Butt contains tubular magazine
Barrel band
Trigger guard and breech-operating lever



▶ SPENCER CARBINE MODEL 1865

Date	1865
Origin	US
Weight	3.7kg (8lb)
Barrel	51cm (20in)
Calibre	.50in

For this model, Christopher Spencer amended the design of his original repeater rifle and carbine to eliminate minor faults. The 1865 carbine had six-groove rifling. It was also made under contract by the Burnside Rifle Company.


Hammer
Rear sight
Trigger guard and cocking lever
Locking catch for cocking lever

▼ WINCHESTER CARBINE MODEL 1866

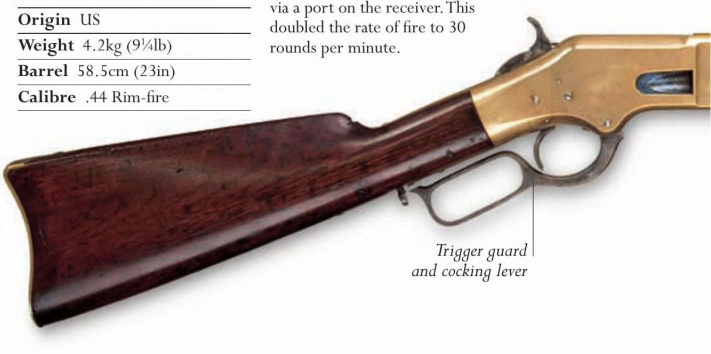
Date	1866
Origin	US
Weight	4.2kg (9¼lb)
Barrel	58.5cm (23in)
Calibre	.44 Rim-fire

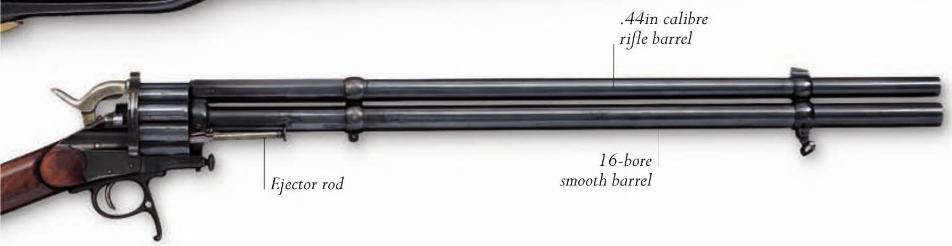
A modified Henry Model 1860, the 1866 allowed the reloading – even part-full – of a magazine via a port on the receiver. This doubled the rate of fire to 30 rounds per minute.

▲ HENRY MODEL 1860

Date	1860
Origin	US
Weight	4kg (8¾lb)
Barrel	51cm (20in)
Calibre	.44in Rim-fire

In Tyler Henry's repeating rifle, an under-lever ejected a spent round, chambered a new one, and left the action cocked. A two-piece bolt joined by a toggle-joint locked the action.

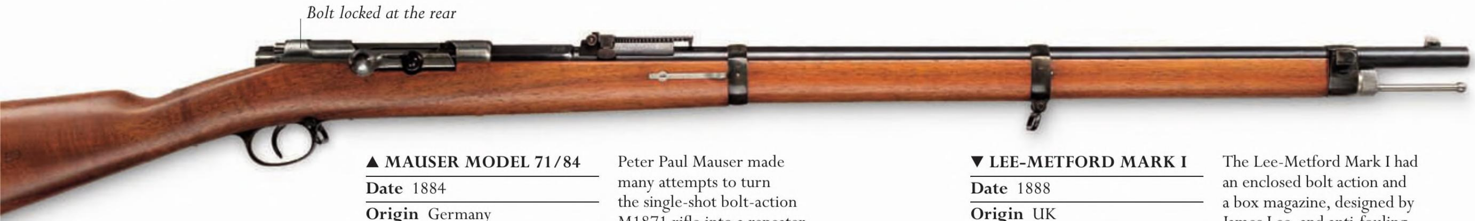



.44in calibre rifle barrel
Ejector rod
16-bore smooth barrel

◀ LEMAT REVOLVER RIFLE

Date	1872
Origin	France/US
Weight	2.2kg (4¾lb)
Barrel	62.8cm (24¾in)
Calibre	.44in and 16-bore

Based on a similar pistol, the LeMat Revolver Rifle had two barrels. The lower, charged with shot, acted as the axis pin for the nine-chambered cylinder, which was charged with ball cartridges.


Bolt locked at the rear

▲ MAUSER MODEL 71/84

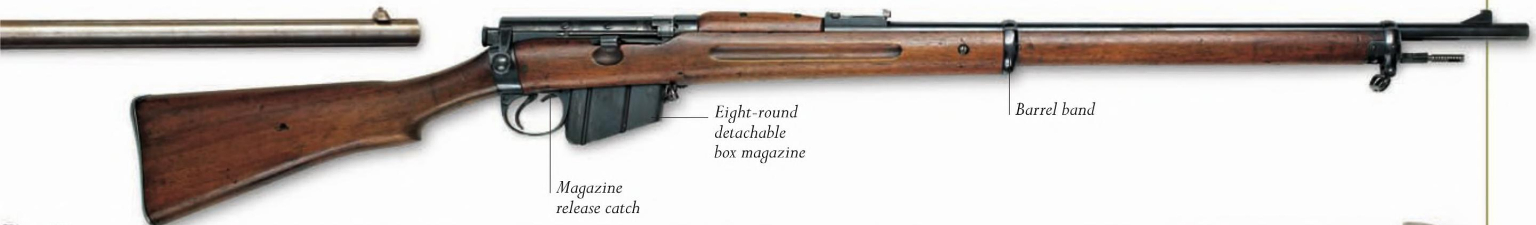
Date	1884
Origin	Germany
Weight	4.6kg (10lb)
Barrel	83cm (33in)
Calibre	11 × 60mm Rim-fire

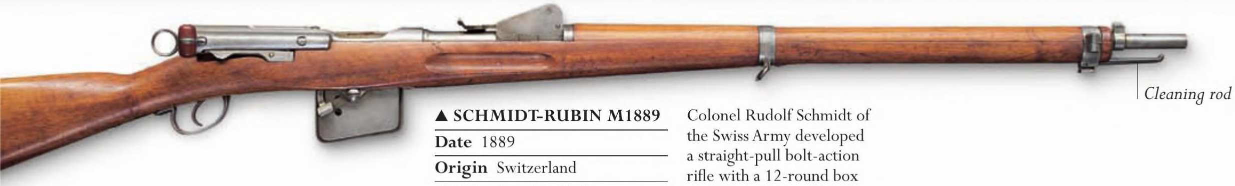
Peter Paul Mauser made many attempts to turn the single-shot bolt-action M1871 rifle into a repeater. The Model 71/84 suffered from weaknesses in the design of its magazine.

▼ LEE-METFORD MARK I

Date	1888
Origin	UK
Weight	4.3kg (9½lb)
Barrel	76.7cm (30in)
Calibre	.303in (black powder)

The Lee-Metford Mark I had an enclosed bolt action and a box magazine, designed by James Lee, and anti-fouling rifling, developed by William Metford. The Mark II followed in 1890.


Eight-round detachable box magazine
Barrel band
Magazine release catch


Cleaning rod

▲ SCHMIDT-RUBIN M1889

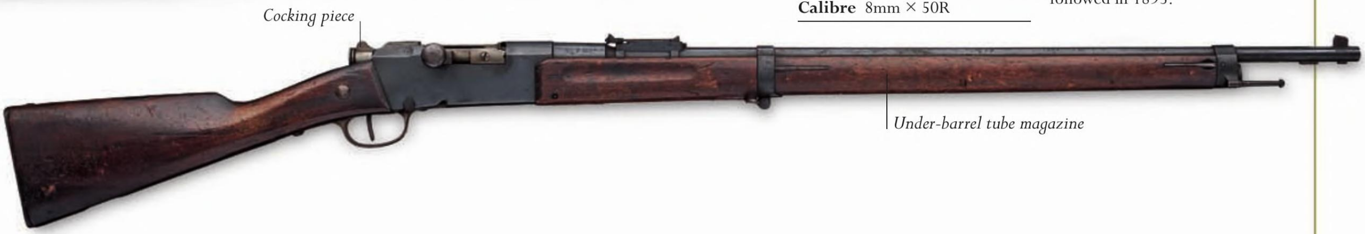
Date	1889
Origin	Switzerland
Weight	4.45kg (9¾lb)
Barrel	78cm (31in)
Calibre	7.5 × 55mm

Colonel Rudolf Schmidt of the Swiss Army developed a straight-pull bolt-action rifle with a 12-round box magazine. It remained in service, though slightly modified, until 1931.

▼ LEBEL MLE 1886/93

Date	1893
Origin	France
Weight	4.3kg (9½lb)
Barrel	80cm (32in)
Calibre	8mm × 50R

The Lebel MLE 1886 was the first rifle to fire a small-calibre, jacketed bullet propelled by smokeless powder. This modified version followed in 1893.


Cocking piece
Under-barrel tube magazine

UNIFORMS AND INSIGNIA OF 19TH-CENTURY ARMIES

The taste for elaborate, colourful, and imposing uniforms established by European armies in the Napoleonic era influenced the outfitting of soldiers throughout the 19th century. The French army under Napoleon Bonaparte is often celebrated as the high point of style and decoration in military uniforms, but – if anything – uniforms became even more intricately embellished and detailed in the decades following his defeat in 1815. Right through until the eve of World War I, in 1914, many armies were clad in distinctive uniforms in traditional colours, featuring outmoded elements of equipment, such as the sabretache.

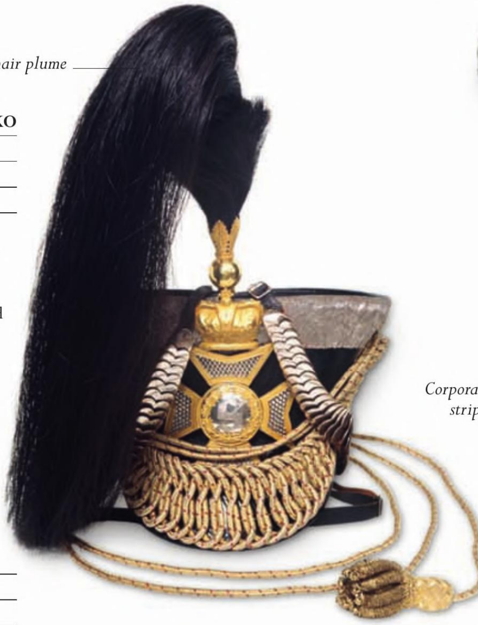
▶ BRITISH BELL-TOP SHAKO

Date 1830

Origin UK

Material Felt, leather, brass

This cavalryman's bell-top shako – designed to make the wearer look taller and more imposing – was one of several rather impractical designs of the period that followed the highly ornamented "Regency" shako of 1822.



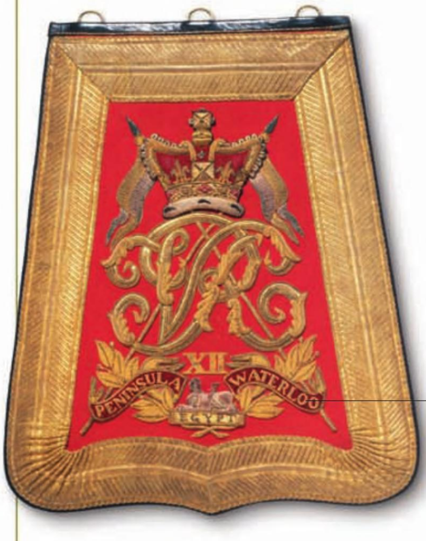
▼ BRITISH CAVALRY OFFICER'S SABRETACHE

Date 1830

Origin UK

Material Leather

British cavalry wore the sabretache – a leather bag suspended from a cavalryman's belt – from the late 1700s onwards. In the 1800s, the sabretache was often restricted to ceremonial wear, but British cavalry wore it in the Crimean War (1853–56).



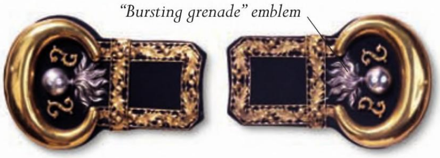
▲ BRITISH CAVALRYMAN'S EPAULETTES

Date 1830

Origin UK

Material Wool, metallic thread

These epaulettes were probably worn by a cavalryman in the "Scots Greys" (officially the 2nd Dragoons), who were celebrated for their mounted charge at the Battle of Waterloo. The "bursting grenade" emblem, originally belonging to the Grenadiers, was associated with elite regiments.



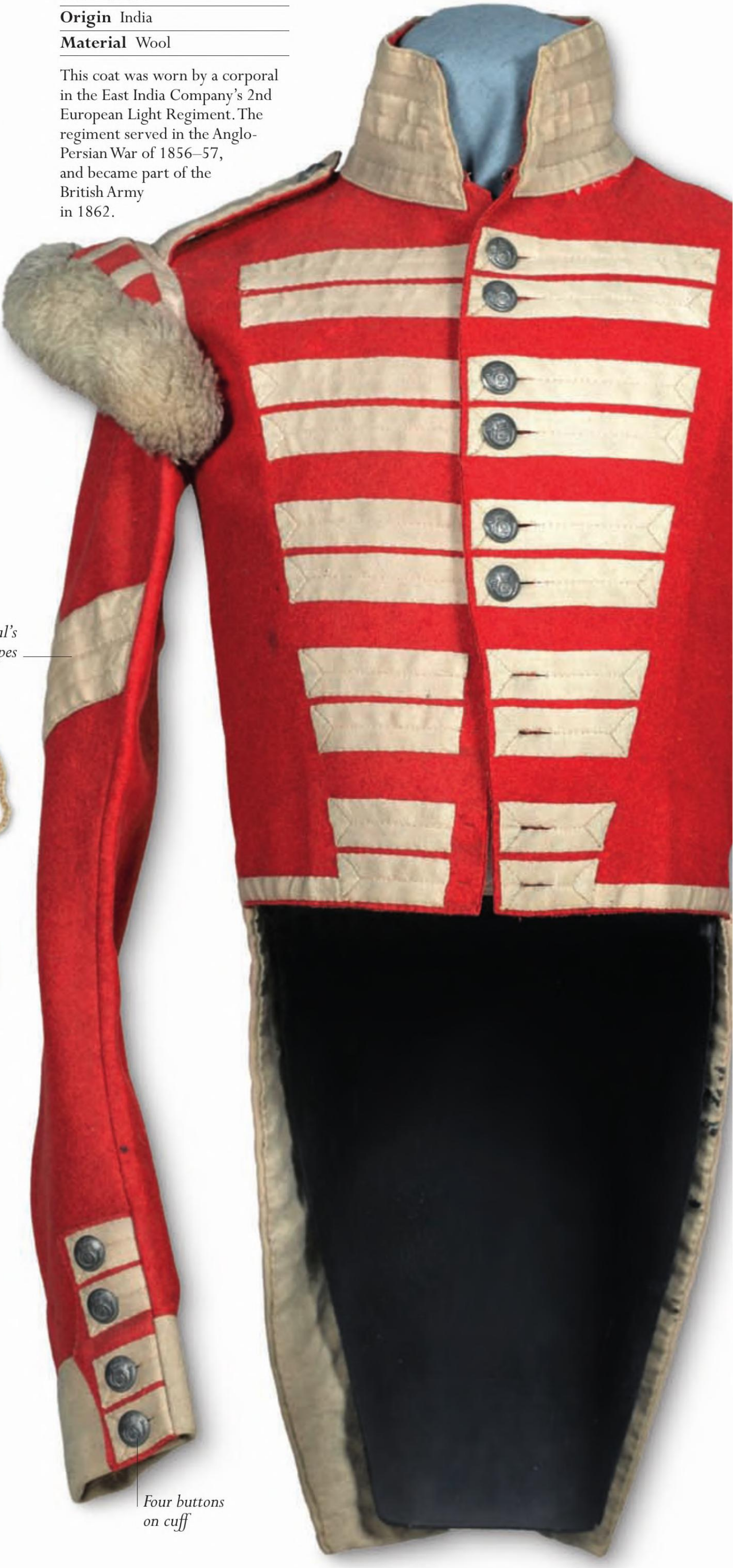
▼ BRITISH INFANTRY CORPORAL'S DRESS COAT

Date c.1850

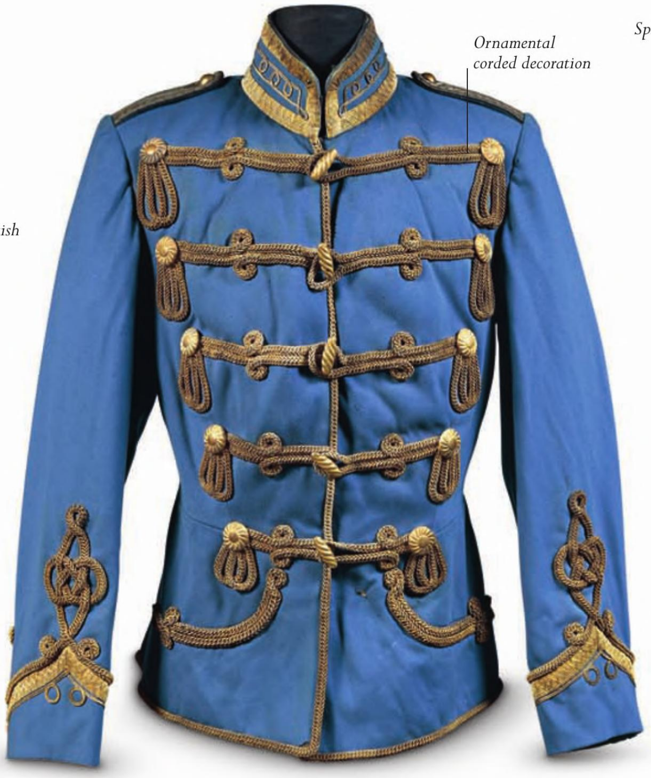
Origin India

Material Wool

This coat was worn by a corporal in the East India Company's 2nd European Light Regiment. The regiment served in the Anglo-Persian War of 1856–57, and became part of the British Army in 1862.



Traditional madder red colour of British uniforms



Ornamental corded decoration

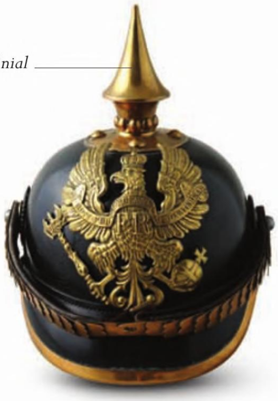
▲ FRENCH HUSSAR'S PARADE JACKET

Date 1871

Origin France

Material Wool

This lieutenant's jacket is from the 9th Regiment of Hussars in the French army. Right through to 1914, hussar regiments kept a role in the French, British, Russian, and several other European armies. They functioned as light cavalry, and were celebrated for their highly elaborate parade uniforms.



Spike finial

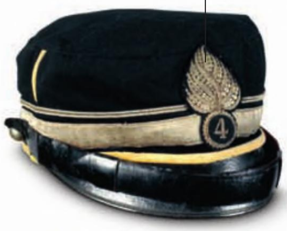
◀ PRUSSIAN PICKELHAUBE

Date 1867

Origin Prussia

Material Leather

The *Pickelhaube* spiked military helmet was designed in 1842 by King Frederick William IV of Prussia. It was made of boiled leather with metal trim and spike. This 1867 version was worn in the Franco-Prussian War of 1870–71.



Insignia of 4th cavalry regiment of Genova

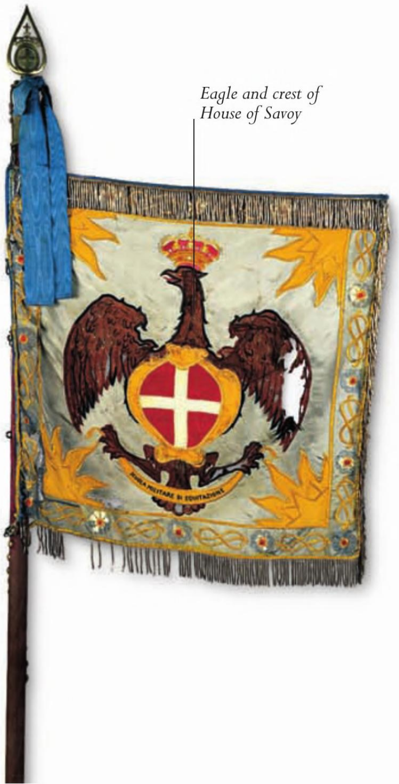
▶ ITALIAN CAVALRY OFFICER'S CAP

Date 1876

Origin Italy

Material Felt, leather

Italy was one of the first countries to move away from wearing brightly coloured uniforms, introducing grey-green ones in 1909 – around the same time that the Russians switched to khaki. This blue cap was worn by a cavalry officer in the late 19th century.



Eagle and crest of House of Savoy

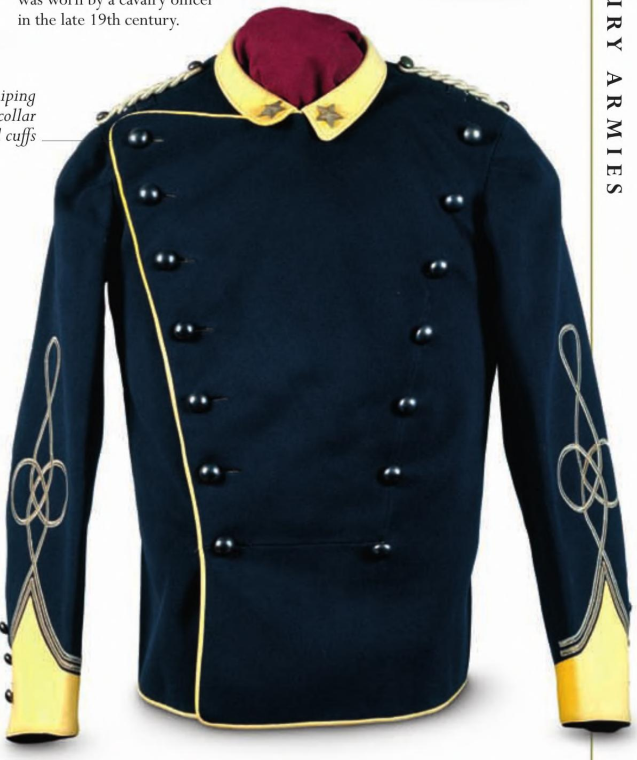
▶ ITALIAN CAVALRY FLAG

Date c.1880

Origin Italy

Material Wool

The guidon, or military standard, remained brightly coloured as uniforms became more muted, functioning as a symbol of identity and tradition. This cavalry flag bears the coat of arms of the Italian House of Savoy, which ruled Italy for 85 years from 1861–1946.



Yellow piping matches collar and cuffs

▲ ITALIAN CAVALRY JACKET

Date 1876

Origin Italy

Material Wool

Until the development of chemical dyes towards the end of the 19th century, many colourful uniforms, such as this elegant blue Italian cavalry jacket, would have been issued in slightly varying shades.

EARLY INDUSTRIAL WARFARE

THE BATTLE OF ANTIETAM

Antietam displayed the weaponry and tactics of the American Civil War at their most deadly. Fought at Sharpsburg, Maryland, on 17 September 1862, it was the costliest day's fighting in American history, with 22,700 Union and Confederate soldiers killed or wounded.

At Sharpsburg a Union army about 75,000 strong, commanded by General George B. McClellan, faced a much weaker Confederate army led by General Robert E. Lee. The Confederates had taken up a defensive position behind Antietam Creek, where they did not dig earthworks but made optimal use of features such as woods, hills, and fences. Lee was still assembling scattered forces when the battle began, but eventually 38,000 Confederate troops would take part.

After a hard marching campaign in Maryland, the Confederates were in poor shape – a Union officer described the troops as "filthy, sick, hungry, and miserable". The Union troops, on the other hand, had been well equipped and supplied by Northern factories.

On the day before the battle began McClellan sent troops across Antietam Creek to General Lee's left. The Confederates observed the movement, and soldiers under General Thomas "Stonewall" Jackson got into position to face a flank attack at dawn on 17 September.

The battle opened with an exchange of cannon fire from the batteries that each side had established on high ground. Union troops then marched onward to a cornfield where Jackson's infantry awaited them. After bringing forward their cannon, the Union divisions swept the cornfield with canister shot – anti-personnel munitions that decimated the Confederates. The Union troops pressed forward and hours of desperate infantry fighting ensued. Men exchanged fire in the open, inflicting and sustaining heavy losses. Groups of men were marshalled by their officers in attacks and counterattacks, especially around and through an area known as West Wood. Soldiers were armed with rifled muskets – muzzle-loaded weapons capable of three or four shots a minute – although in places men fought at close quarters with bayonets or wielded their muskets as clubs. Combat on the left flank eventually subsided due to shock and exhaustion on both sides.

FIRING FROM COVER

Meanwhile, elsewhere on the battlefield, the Confederates, using their muskets, were demonstrating the effectiveness of infantry when firing from cover against troops advancing in the open. In the centre, some 2,500 men held a sunken road – later known as Bloody Lane – against repeated frontal assaults, inflicting thousands of casualties before being overrun.

Further to the Confederate right, Union General Ambrose Burnside tried to move troops over the Creek across a bridge, under the fire of Confederate sharpshooters and cannon. Time and again the Union soldiers were cut down, and only established themselves on the other side of the Creek after bringing up their own artillery in support.

By late afternoon the Confederates had been outflanked on the right and looked about to be beaten, when Confederate reinforcements marching from Harpers Ferry arrived and counterattacked, causing Union troops to retreat. The cautious McClellan had held 20,000 infantry and cavalry in reserve throughout. He made no attempt to resume fighting the next day, and Lee withdrew his battered army to Virginia.

SURVIVORS OF BATTLE
A Union field artillery battery is photographed after the battle. Smoothbore cannon, like the one shown here, caused a large percentage of the casualties.

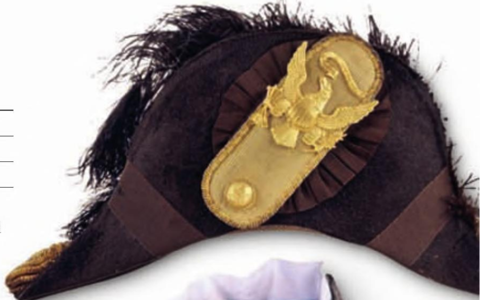
AMERICAN CIVIL WAR UNIFORMS

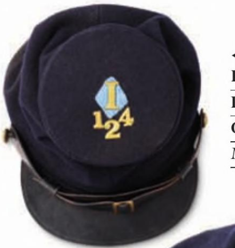
In the American Civil War of 1861–65, soldiers of the northern Union were well kitted out. From 1861, they were issued with standard issue uniforms and equipment mass-produced in factories in the north, on the orders of the War Department. By contrast, the soldiers of the southern Confederate States were often ill-equipped, and had to overcome a shortage of cartridges, uniform, tents, blankets, pay, and food. Sometimes they even had to march barefoot or rely on supplies of boots "liberated" from the Union forces.

▶ UNION OFFICER'S COCKED HAT

Date 1861
Origin US
Material Wool

Officers were entitled to wear this bicorne or "cocked hat" with a black rosette, ostrich plumes, and, attached to the side, a gilt Union eagle.

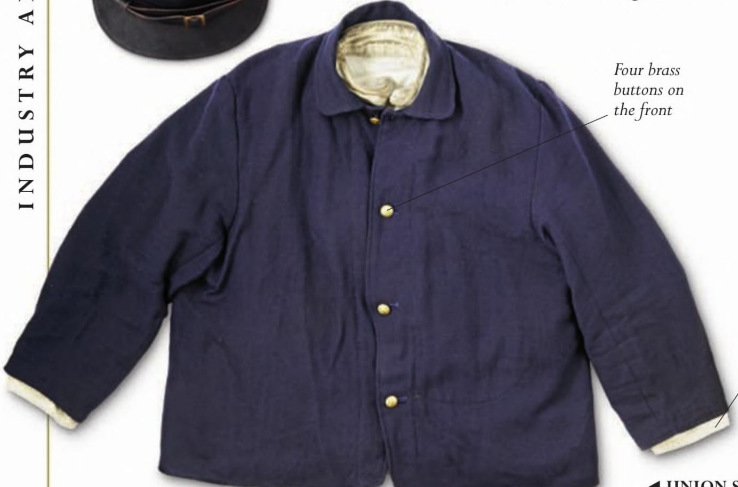




◀ UNION SOLDIER'S FORAGE CAP

Date 1861
Origin US
Material Wool

Soldiers in the Union forces attached a regimental corps badge and brass numbers to the top of their forage cap. In this case, the "I" signifies "First Corps" and the "124" the New York 124th regiment.



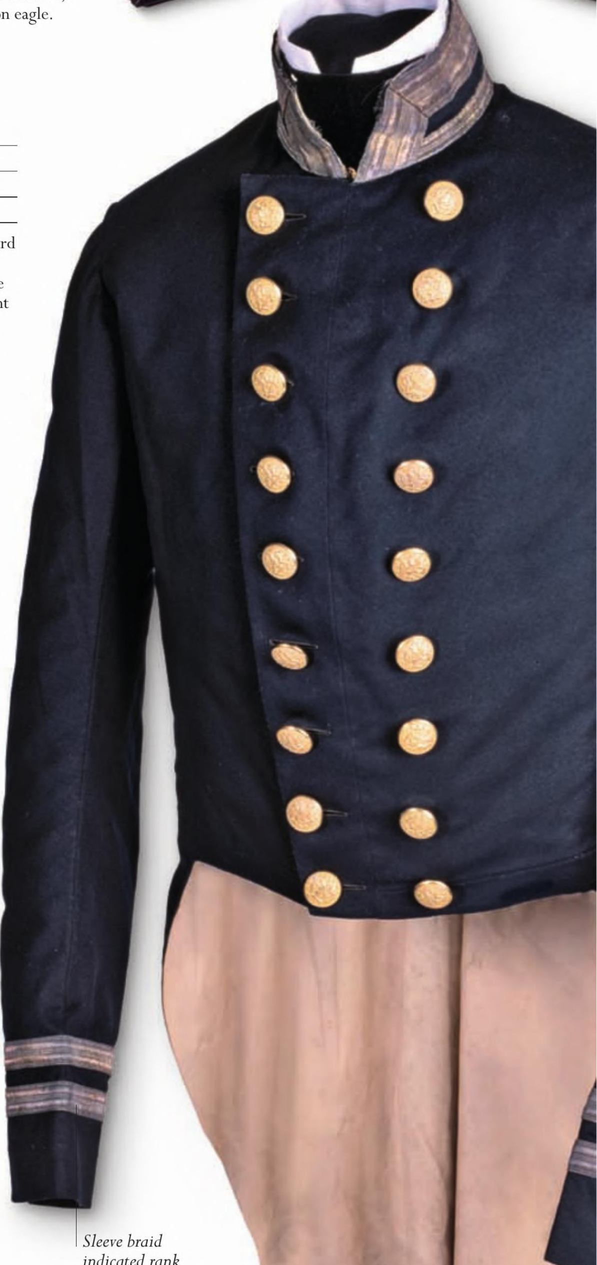
Four brass buttons on the front

Domet (cotton warp and wool weft) flannel ensured warmth

▶ UNION OFFICER'S DRESS JACKET

Date 1861
Origin US
Material Wool

Rather than wearing standard issue, officers bought their own uniform. The influence of the French army is evident in this dress jacket with upright collar, sleeve braid, and brass buttons.

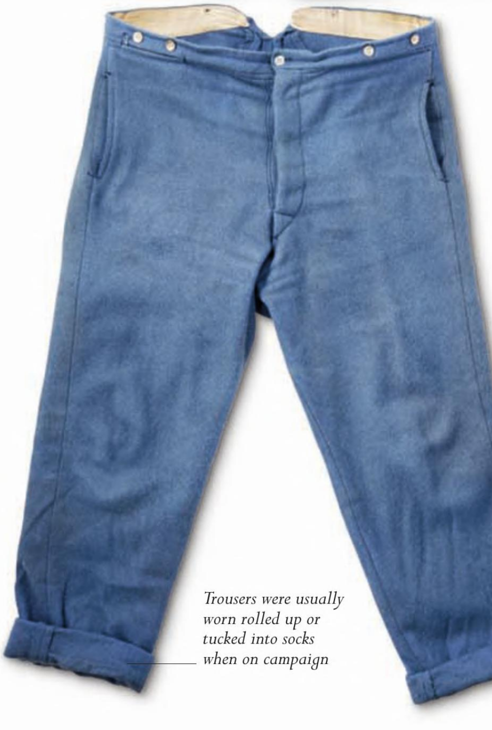


Sleeve braid indicated rank

◀ UNION SOLDIER'S UNIFORM

Date 1861
Origin US
Material Wool

Union soldiers wore a dark blue fatigue jacket and standard issue light blue trousers. Union forces kit was produced in a range of standard sizes to facilitate mass production.

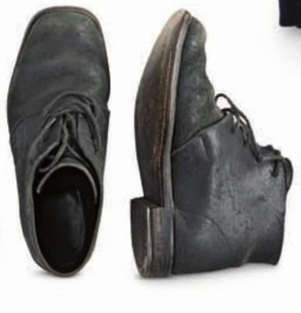


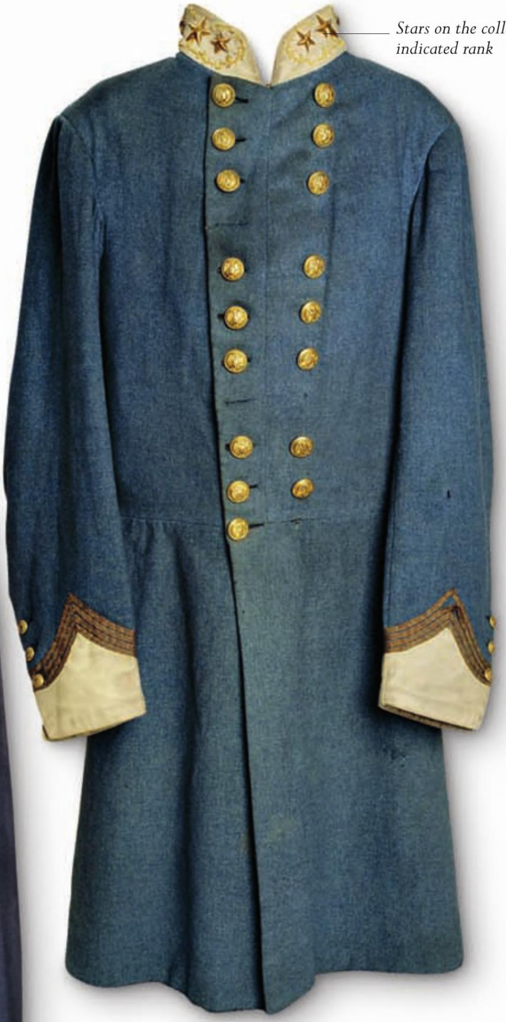
Trousers were usually worn rolled up or tucked into socks when on campaign

▼ UNION SOLDIER'S BOOTS

Date 1861
Origin US
Material Leather

Union leather "bootees" were made with heavy leather soles. The heels were tacked together with wooden pegs or stitched with thick thread.





Stars on the collar indicated rank

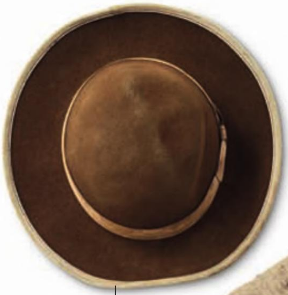
▲ CONFEDERATE OFFICER’S FROCK COAT

Date 1861

Origin US

Material Wool

Frock coats were issued at the beginning of the war, but shortages of cloth later led to the introduction of waist-length jackets. The colour grey was initially chosen because the dye could be made cheaply.



Brim was worn turned up

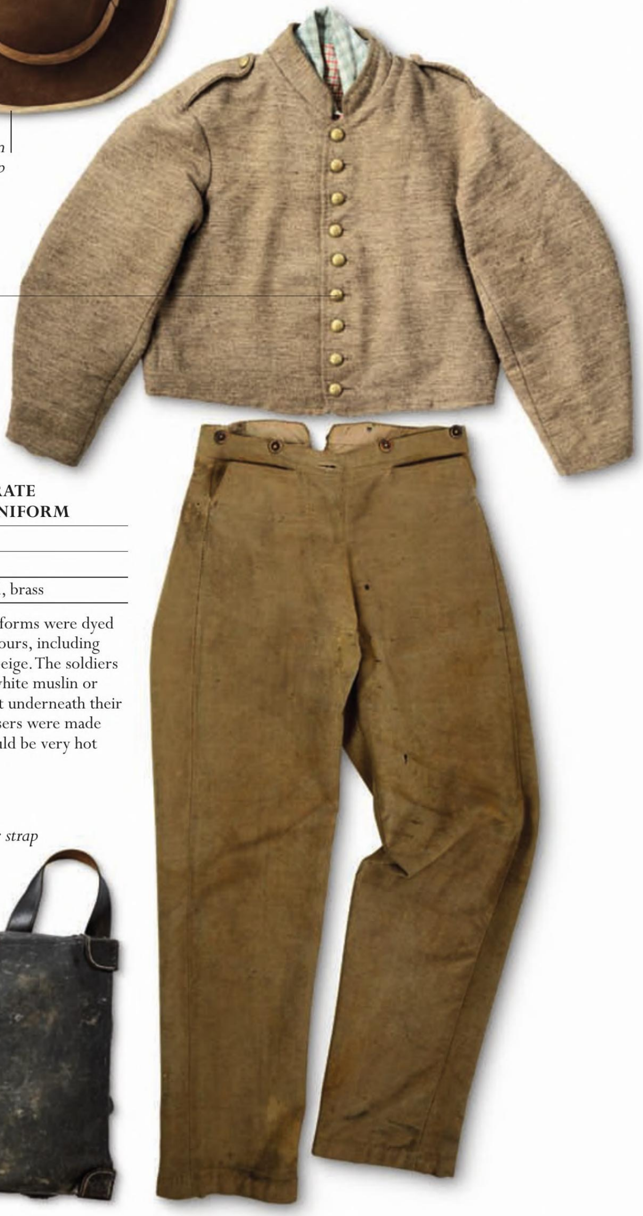
◀ CONFEDERATE “BEEHIVE” SLOUCH HAT

Date 1862

Origin US

Material Wool, felt

Many Confederate infantrymen wore low-crown “beehive” slouch hats, some with a star or another symbol to indicate their home state. Others wore an angled *képi* (peaked cap) or straw hats in summer.



Brass buttons bore the Federal eagle

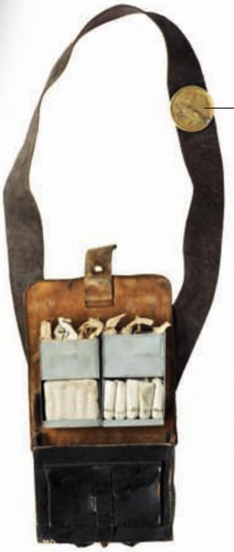
▶ CONFEDERATE INFANTRY UNIFORM

Date 1862

Origin US

Material Wool, brass

Confederate uniforms were dyed in a range of colours, including grey, blue, and beige. The soldiers usually wore a white muslin or grey flannel shirt underneath their jacket. The trousers were made of wool, and could be very hot to march in.



Brass eagle emblem

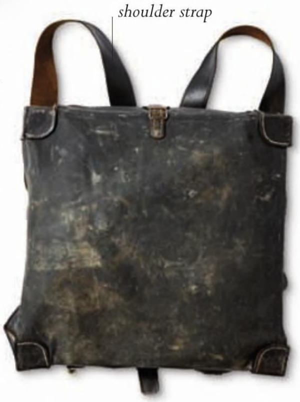
◀ UNION SOLDIER’S CARTRIDGE BOX

Date 1861

Origin US

Material Leather

This box held 40 cartridges – each a paper tube filled with a Minié ball and black powder. The shoulder strap bears the brass Union eagle emblem.



Leather shoulder strap

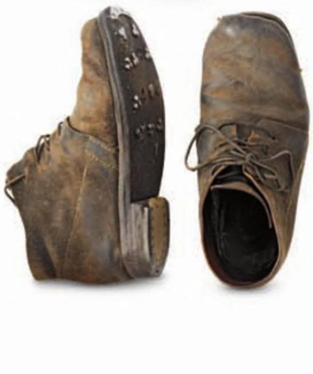
▲ CONFEDERATE SOLDIER’S BACKPACK

Date 1862

Origin US

Material Canvas

Backpacks had a single pocket and sometimes a wooden frame. Soldiers carried a woollen blanket, extra food, and personal items in them, and usually had a cherrywood canteen for drinking water.



◀ CONFEDERATE HOBNAILED BOOTS

Date 1862

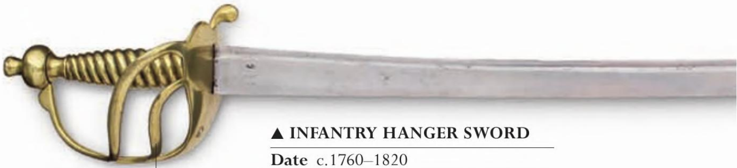
Origin US

Material Leather

Army boots were usually square-toed with hobnails, and had curved horseshoe protectors on the heels to protect against wear and tear during long marches.

INFANTRY AND CAVALRY SWORDS AND BAYONETS

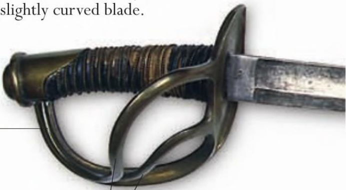
By 1815, infantry swords were becoming little more than ceremonial weapons, although officers and senior NCOs continued to carry them as symbols of rank. The design of these swords was increasingly decorative. In the course of the 19th century, the sword bayonet replaced the infantryman's socket bayonet and hanger sword. The rise of long-range firearms meant that the bayonet was of little use in combat, but infantrymen were still equipped with it because armies believed the weapon fostered an aggressive spirit. In these years, light cavalry used a curved sabre designed for slicing and cutting, while heavy cavalry carried a thrusting sword with a long, straight blade.


Simple two-bar guard

▲ INFANTRY HANGER SWORD

Date	c.1760–1820
Origin	UK
Weight	840g (29½oz)
Length	79.7cm (31¼in)

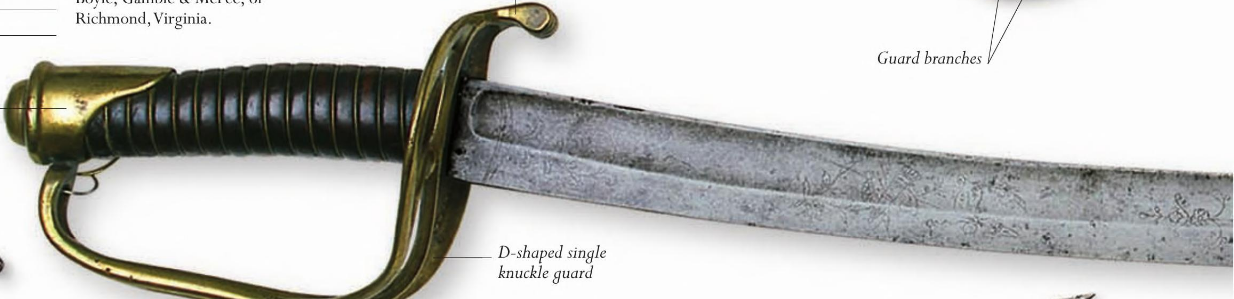
The hanger sword traditionally carried by the infantry was a crude military variant of a short hunting sword, almost always with a straight or slightly curved blade.

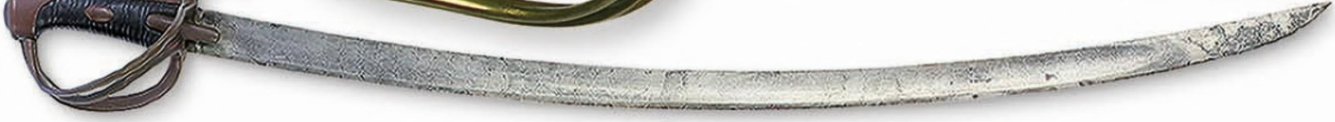

Knuckle guard
Guard branches

▶ "FOOT" OFFICER'S SWORD

Date	c.1820
Origin	US
Weight	1.13kg (2½lb)
Length	73.6cm (29in)

In the American Civil War (1861–65), the artillery had its own swords. This Confederate artillery sabre was made by Boyle, Gamble & McFee, of Richmond, Virginia.

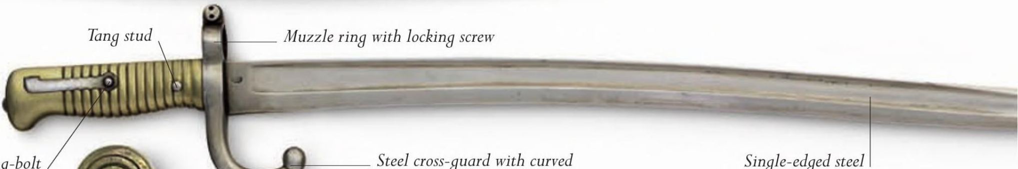

Guard with forward-facing quillon
Pommel cap
D-shaped single knuckle guard

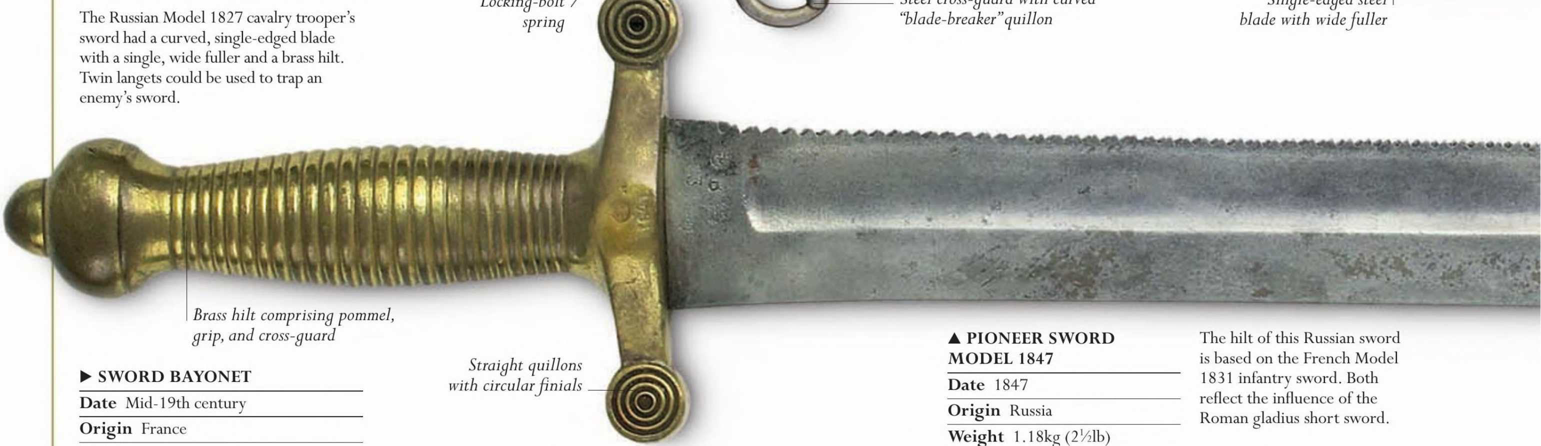

One of the twin langets fixed over cross-guard

▲ MODEL 1827 CAVALRY TROOPER'S SWORD

Date	c.1827
Origin	Russia
Weight	1.22kg (2¾lb)
Length	1.02m (3½ft)

The Russian Model 1827 cavalry trooper's sword had a curved, single-edged blade with a single, wide fuller and a brass hilt. Twin langets could be used to trap an enemy's sword.


Tang stud
Muzzle ring with locking screw
Locking-bolt spring
Steel cross-guard with curved "blade-breaker" quillon
Single-edged steel blade with wide fuller


Brass hilt comprising pommel, grip, and cross-guard
Straight quillons with circular finials

▶ SWORD BAYONET

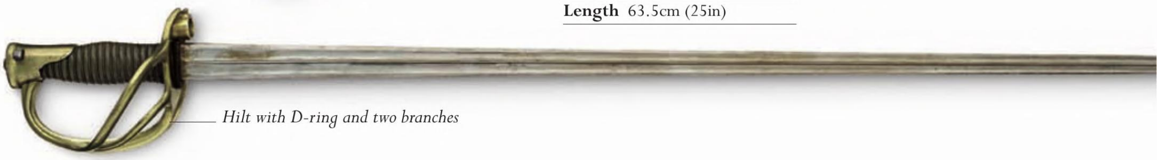
Date	Mid-19th century
Origin	France
Weight	790g (27¾oz)
Length	1.15m (3¾ft)

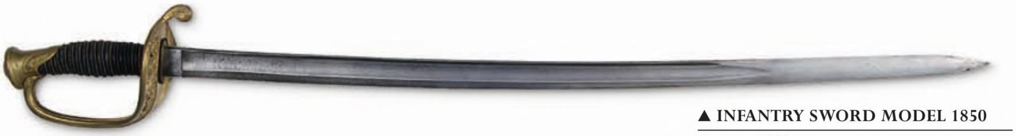
This French sword bayonet, with a long, narrow blade, is unusual in having a basket hilt – a feature usually associated with a cavalry sword.

▲ PIONEER SWORD MODEL 1847

Date	1847
Origin	Russia
Weight	1.18kg (2½lb)
Length	63.5cm (25in)

The hilt of this Russian sword is based on the French Model 1831 infantry sword. Both reflect the influence of the Roman gladius short sword.

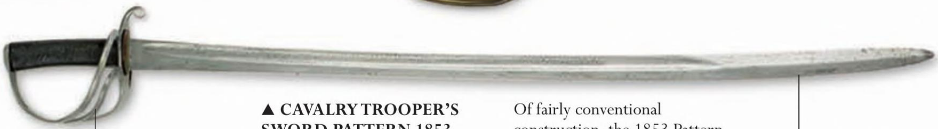

Hilt with D-ring and two branches



▲ INFANTRY SWORD MODEL 1850

Date	c.1850
Origin	US
Weight	1.13kg (2½lb)
Length	76.8cm (30¼in)

In the American Civil War, edged weapons such as this Model 1850 equipped most infantry officers on the Union side. Its single-edged blade is slightly curved, and the leather grip is wrapped in twisted brass wire.


Three-bar steel hilt
Single-edged blade

▲ CAVALRY TROOPER'S SWORD PATTERN 1853

Date	1853
Origin	UK
Weight	1.13kg (2½lb)
Length	1m (3½ft)

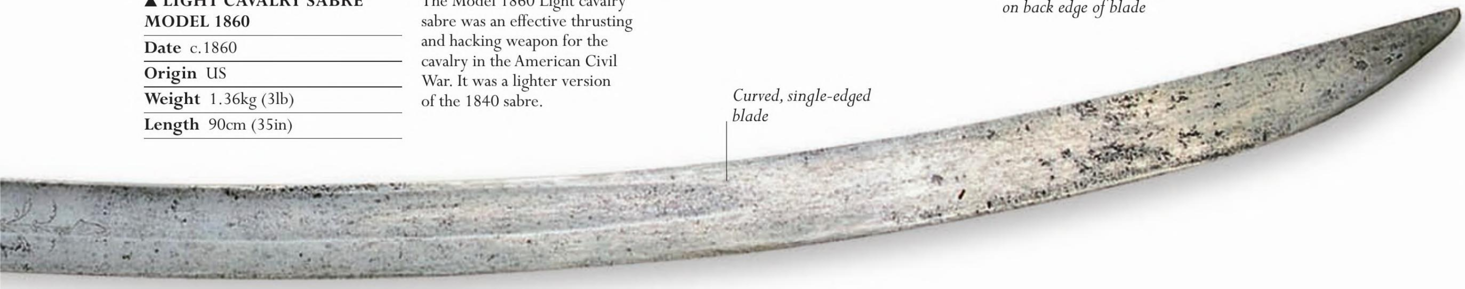
Of fairly conventional construction, the 1853 Pattern cavalry trooper's sword equipped British heavy cavalry in the Crimean War and during some of Britain's subsequent colonial campaigns.

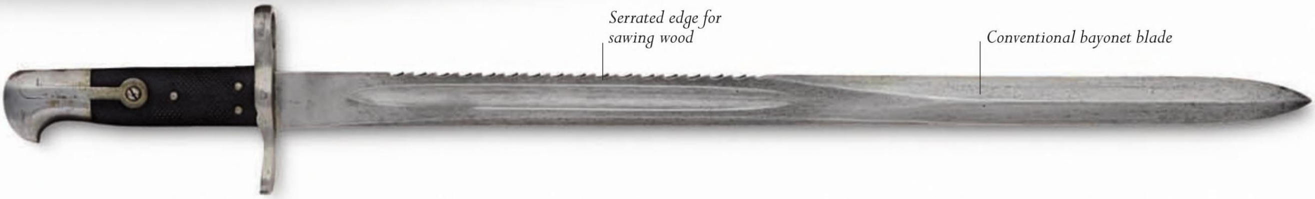
Single-edged blade with short, sharpened section on back edge of blade

▲ LIGHT CAVALRY SABRE MODEL 1860

Date	c.1860
Origin	US
Weight	1.36kg (3lb)
Length	90cm (35in)

The Model 1860 Light cavalry sabre was an effective thrusting and hacking weapon for the cavalry in the American Civil War. It was a lighter version of the 1840 sabre.


Curved, single-edged blade


Serrated edge for sawing wood
Conventional bayonet blade

◀ MLE 1866 CHASSEPOT BAYONET

Date	1866
Origin	France
Weight	760g (27¾oz)
Length	70cm (27½in)

This bayonet is from the Chassepot breech-loading rifle that armed the French during the Franco-Prussian War of 1870–71. The recurved *yataghan*-style blade influenced many European and American designs.

▲ PATTERN 1869 TRIALS BAYONET

Date	1869
Origin	UK
Weight	640g (22½oz)
Length	64.2cm (25in)

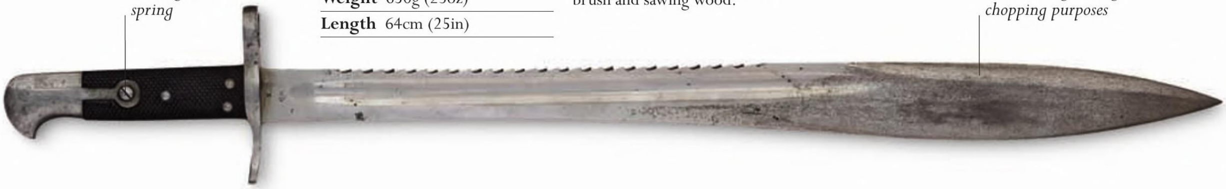
The Elcho bayonets, with their broad blade end, were considered too ungainly, and were not taken up as an official model. This earlier design with a narrower blade had also failed to impress the authorities.

Serrated edge for sawing wood

▼ PATTERN 1871 ELCHO BAYONET

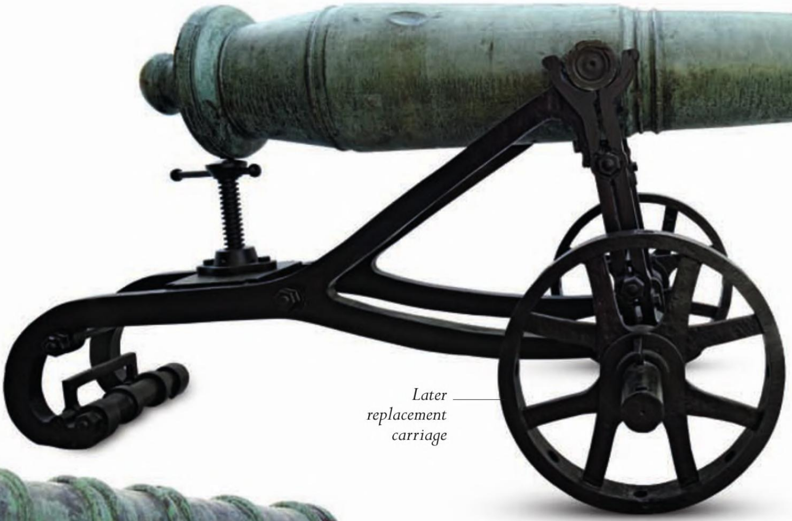
Date	1871
Origin	UK
Weight	650g (23oz)
Length	64cm (25in)

Lord Elcho designed this bayonet to go with the Martini-Henry rifle. Elcho extended the bayonet's range of tasks to include those of hacking down brush and sawing wood.

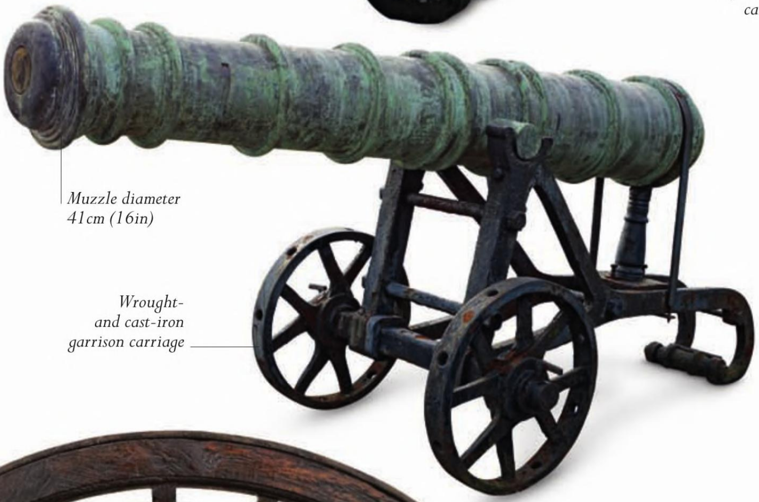

Locking bolt spring
Broad end of blade for chopping purposes

MUZZLE-LOADING ARTILLERY

In the 19th century, infantrymen firing rifled small arms were able to achieve greater range than smoothbore cannon, so attempts were made to apply rifling to field artillery. The first rifled cannon were developed in the 1840s by pioneers including Giovanni Cavalli of Italy, Martin von Wahrendorff of Sweden, and Joseph Whitworth and Charles Lancaster of Britain. Some of these early rifled field guns – such as the rifled Whitworth 12-pounder, which saw service in the American Civil War – were breech- rather than muzzle-loaders. Breech-loaders permitted a higher rate of fire and were generally safer to use, but muzzle-loaders were cheaper to manufacture and required less expensive ammunition. As a result, muzzle-loaders continued to be popular for military use.



Later replacement carriage



Muzzle diameter 41cm (16in)

Wrought- and cast-iron garrison carriage

▶ CHINESE 18-POUNDER

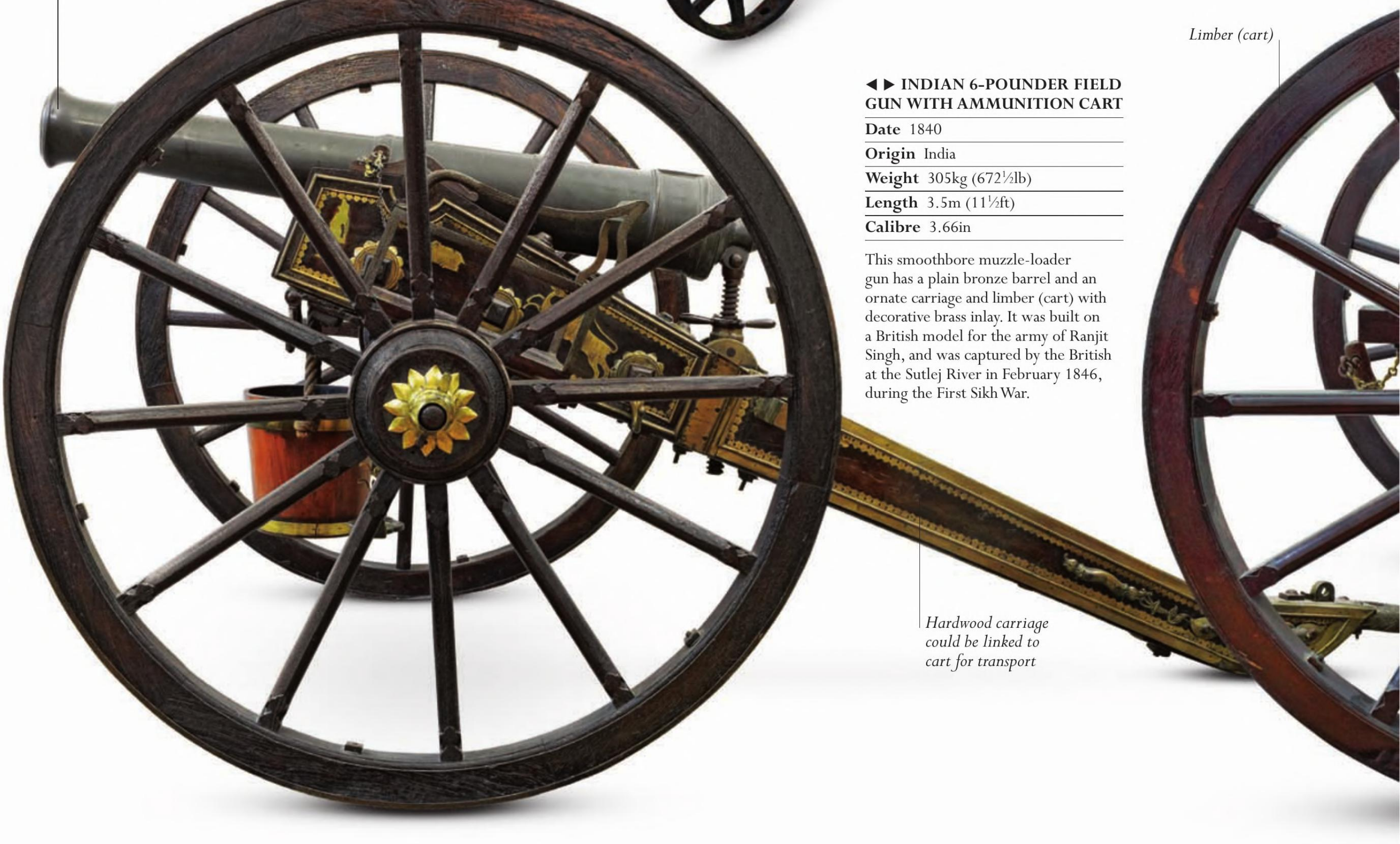
Date	1830
Origin	China
Weight	2.5 tonnes (2.75 tons)
Length	3.2m (10½ft)
Calibre	5.25in

With inscriptions in Chinese on top of its breech, this 18-pounder is 48cm (19in) in diameter. It is mounted on a Russian wrought- and cast-iron carriage, which dates to 1853.

▲ RUSSIAN LICORNE

Date	1793
Origin	Russia
Weight	2.76 tonnes (3 tons)
Length	2.8m (9ft)
Calibre	205mm

This gun, which saw action in the Crimean War (1853–56), could fire horizontally or at an elevated trajectory. The licorne was a development of the howitzer, with a powder chamber in the shape of a cone. It could shoot shells as well as cannonballs.



Plain bronze barrel

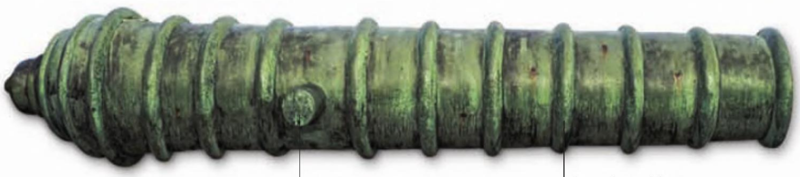
Limber (cart)

Hardwood carriage could be linked to cart for transport

◀ ▶ INDIAN 6-POUNDER FIELD GUN WITH AMMUNITION CART

Date	1840
Origin	India
Weight	305kg (672½lb)
Length	3.5m (11½ft)
Calibre	3.66in

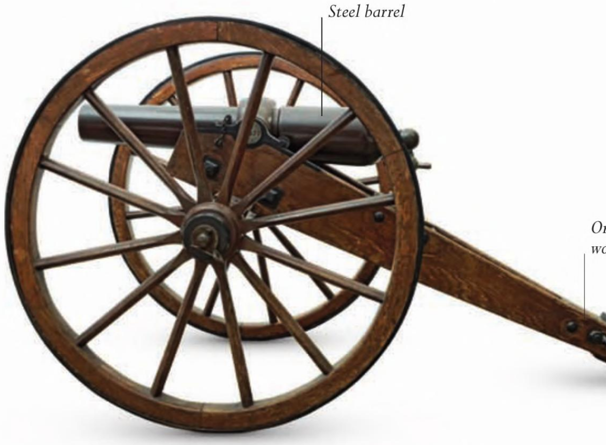
This smoothbore muzzle-loader gun has a plain bronze barrel and an ornate carriage and limber (cart) with decorative brass inlay. It was built on a British model for the army of Ranjit Singh, and was captured by the British at the Sutlej River in February 1846, during the First Sikh War.



◀ CHINESE 32-POUNDER

Date 1841
Origin China
Weight 4.84 tonnes (5.3 tons)
Length 2.74m (8¾ft)
Calibre 19cm

Engravings on the breech indicate that this imposing bronze 32-pounder was cast in August 1841, during the reign of Chinese Emperor Daoguang (1820–50), for coastal defence duties.



▲ BLAKELY RML MOUNTAIN GUN

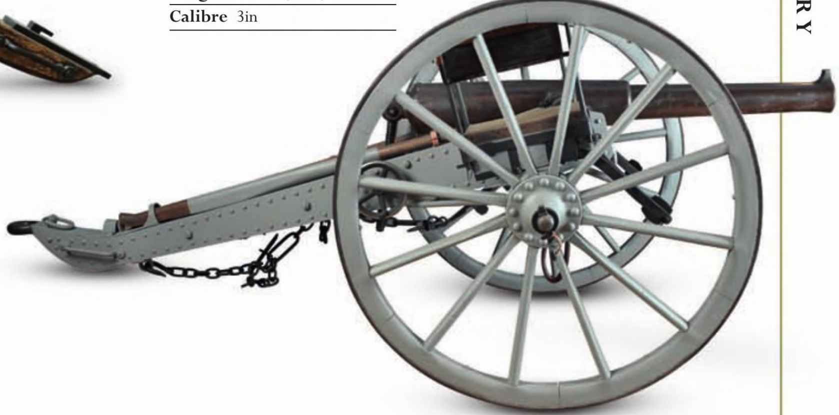
Date 1865
Origin UK
Weight 363kg (800¼lb)
Length 1m (3¼ft)
Calibre 2.75in

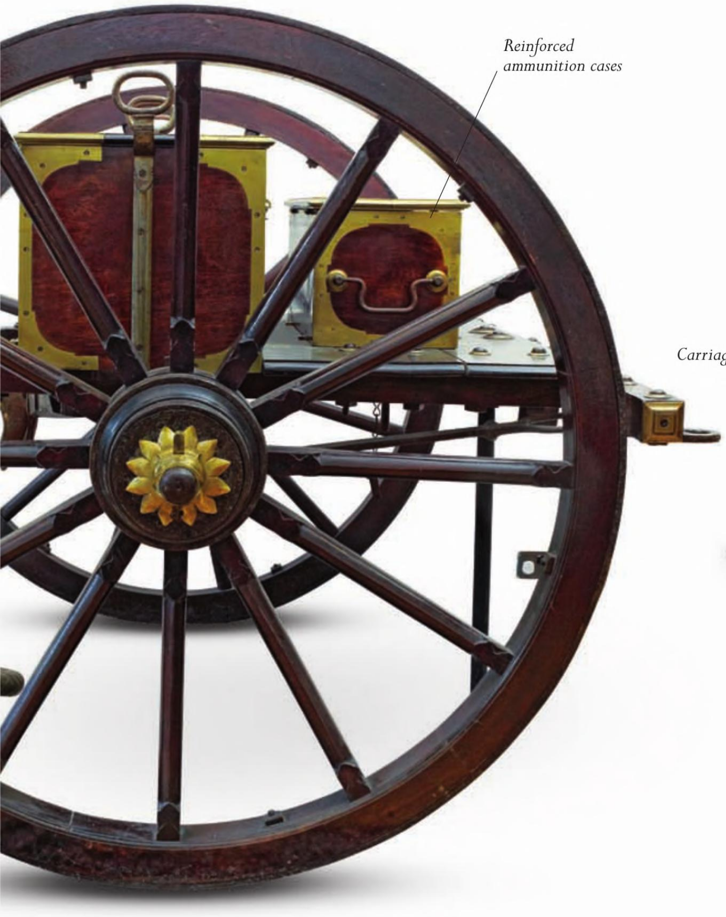
In mountainous terrain, armies needed lighter, more manoeuvrable field guns, and mountain guns were developed to meet this need. This gun, manufactured by the innovative Blakely Ordnance Company, has a steel barrel with six-groove rifling and reinforcement at the breech in the form of an additional steel tube ("jacket").

▼ BRITISH 9-POUNDER FIELD GUN

Date 1876
Origin UK
Weight 1.04 tonnes (1.14 tons)
Length 1.79m (5¾ft)
Calibre 3in

Field guns like this muzzle-loading rifled British 9-pounder played an important role in both sieges and field battles in the British Army's overseas engagements of this period.

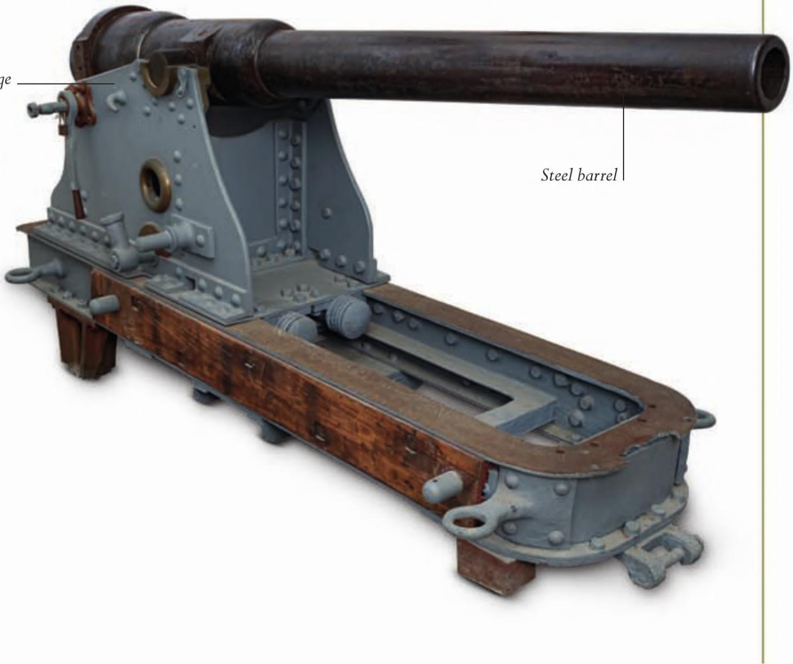




▼ ARMSTRONG RML 12-POUNDER

Date 1878
Origin UK
Weight 415kg (915lb)
Length 2.23m (7¼ft)
Calibre 3in

The initials RML in the gun title stand for "rifled muzzle-loader". This steel 12-pounder was manufactured by Armstrong in Newcastle, northern England, for merchant marine use.



KEY **EVENTS**

19TH CENTURY

- **1830–48** France invades Algeria, but Abd el-Kadir leads resistance to the French occupation of the territory until forced to surrender in 1848.
- **1845–72** Maori opposition to the British colonization of New Zealand is overcome in a series of hard-fought wars.
- **1857–58** A rebellion against British rule in India is put down by armed force.
- **1860** A combined Anglo-French army invades China and occupies Beijing, looting and burning Chinese imperial palaces.
- **1868** In Japan, the Tokugawa Shogunate ends and the period of the Meiji Restoration begins, during which time Japan modernizes its armed forces and society.
- **1876–77** In the Black Hills War, Sioux warriors led by Crazy Horse mount the last serious resistance to the westward expansion of the United States.
- **1879** At Rorke's Drift, 150 British soldiers armed chiefly with Martini-Henry rifles successfully resist repeated attacks by 4,000 Zulu warriors.
- **1898** An Anglo-Egyptian army defeats the Sudanese Mahdists at Omdurman (see pp.250–51). The Sudanese are cut down by rapid-fire rifles and Maxim guns.
- **1900** In the Boer War, Boer militia armed with the latest German weapons inflict a notable defeat on the British Army at Spion Kop.

KEY DEVELOPMENT

THE WARS OF EMPIRES

In the 19th century, a gulf opened up between the military technology of Europe and North America, and the rest of the world. Pre-industrial societies, such as China, Japan, and Africa, could not withstand the firepower of imperial armies.

The armies of the world's great powers underwent a technological revolution between 1815 and 1914, progressing from flintlock muskets to repeater rifles firing metal cartridges, and from smoothbore muzzle-loading cannon to rifled guns firing high-explosive shells. Widely adopted in the1890s, the Maxim gun – the first self-powered machine-gun – became a symbol of technological progress and the alleged superiority of European civilization. Steamships projected this increased firepower worldwide in campaigns waged on every continent.

Some wars of the imperialist era were between powers that had fallen behind in the race for military modernization. The defeat of China by European forces, in the Opium Wars of 1839–42 and 1856–60, demonstrated how a country long at the forefront of technological innovation and military organization could suddenly find itself defenceless at a time of rapid change. Both China and Japan attempted to adopt the technology of the West, but China's defeat by Japan in the war of 1894–95, and its invasion by European powers in response to the Boxer rebellion of 1900, showed that the Chinese had failed. Japan, in contrast, established itself as the sole Asian modern military power after its victory over Russia in 1904–05 (see pp.264–65), in which it deployed the latest military technology, from steel battleships and torpedo boats to machine-guns, rifled artillery, and field telephones.

BATTLES WITH TRIBES

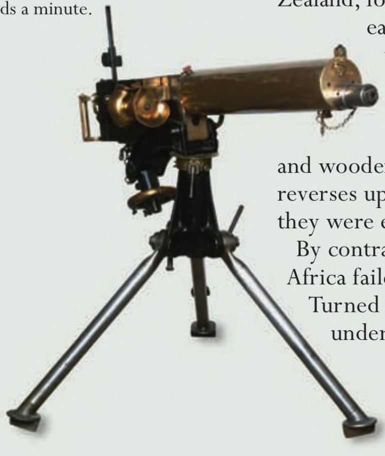
Other conflicts of the era led the armies of Europe and North America into combat with indigenous tribal societies. These tribal groups were formidable in their varied traditional styles of warfare, and often succeeded in integrating modern firearms into their fighting techniques. The Maori of New Zealand, for example, acquired muskets from the early 1800s, and used them in a series of wars – first against one another, and then against European settlers backed by the British Army. Firing rifled muskets from elaborate defensive earthworks and wooden palisades, the Maori inflicted notable reverses upon the British in the 1860s, although they were eventually defeated.

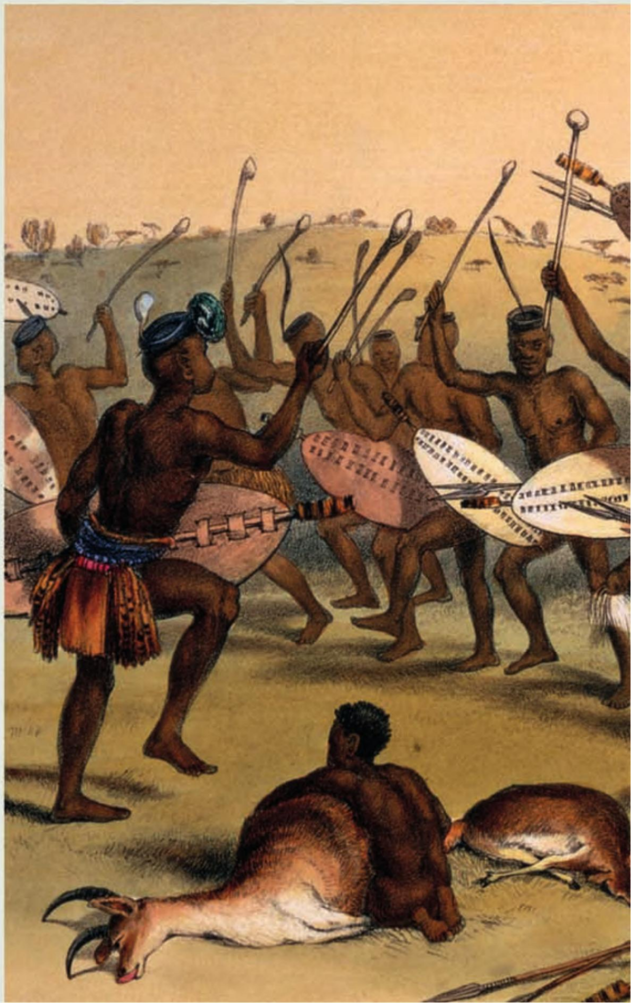
By contrast, however, the Zulu of southern Africa failed to make effective use of firearms. Turned into an impressive military machine under the leadership of Shaka (1816–28), they had achieved regional dominance by fighting aggressive wars against neighbouring peoples with stabbing spears and cowhide shields. They mostly relied on the same equipment against an invading British Army in 1879, using rifles only for a scattered volley, before charging to engage at close quarters. Despite a victory at Isandlwana, the Zulu were soon forced to concede defeat due to casualties inflicted by British bullets and bayonets.

FRONTIER BATTLES

Expanding their territory westwards, the US fought Plains Indian tribes such as the Sioux, Cheyenne, and Arapaho from the 1860s to the 1880s. The Plains Indians used modern technology – firearms, including repeater rifles, and steel knives – but they fought best with traditional bows and spears.

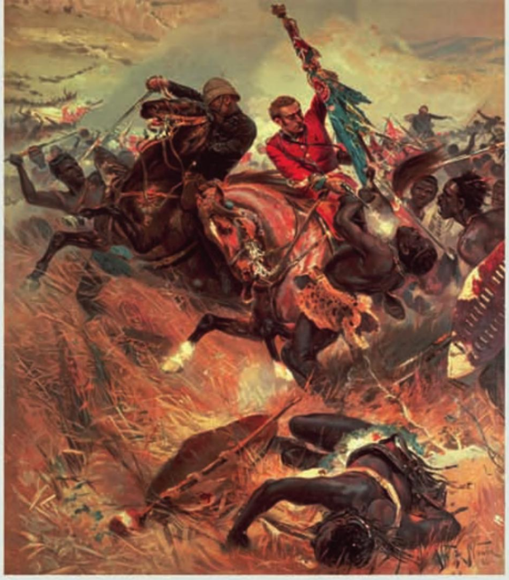
▼ MAXIM GUN
Invented in 1884 by Sir Hiram Maxim, the recoil-operated Maxim gun was the first fully automatic weapon, firing for as long as the trigger was held down. Its maximum rate of fire was 500 rounds a minute.





Although they inflicted a memorable defeat on General George Custer's 7th US Cavalry at the Battle of the Little Bighorn in June, 1876, the Plains Indians mostly fought a guerrilla-style war of small-scale raids and ambushes. The US used brutal but effective counterinsurgency tactics, attacking encampments and destroying food supplies.

The UK resorted to a similar strategy in the later stages of the Boer War of 1899–1902 (see pp. 256–57), when the mounted Boer commandos turned to guerrilla warfare. Armed with Mauser magazine rifles, Creusot artillery, and Maxim guns, the Boers shocked the British Army out of its complacency. By the early 20th century, it had become clear that any war fought between armies equally equipped with the latest weaponry was simply a bloodbath.



◀ **THE BATTLE OF ISANDLWANA**
In January, 1879, about 1,500 British soldiers were attacked by a Zulu force outnumbering them ten to one. After losing their field guns early in the action, the British were overrun, and almost all were killed.

> "I rejoice to find that the sympathy of **well-nigh the whole world** is on our side in **this struggle for right and liberty**"
>
> **STATE PRESIDENT OF THE SOUTH AFRICAN REPUBLIC, PAUL KRUGER**, *THE MEMOIRS OF PAUL KRUGER*, 1902

KEY **BATTLE**

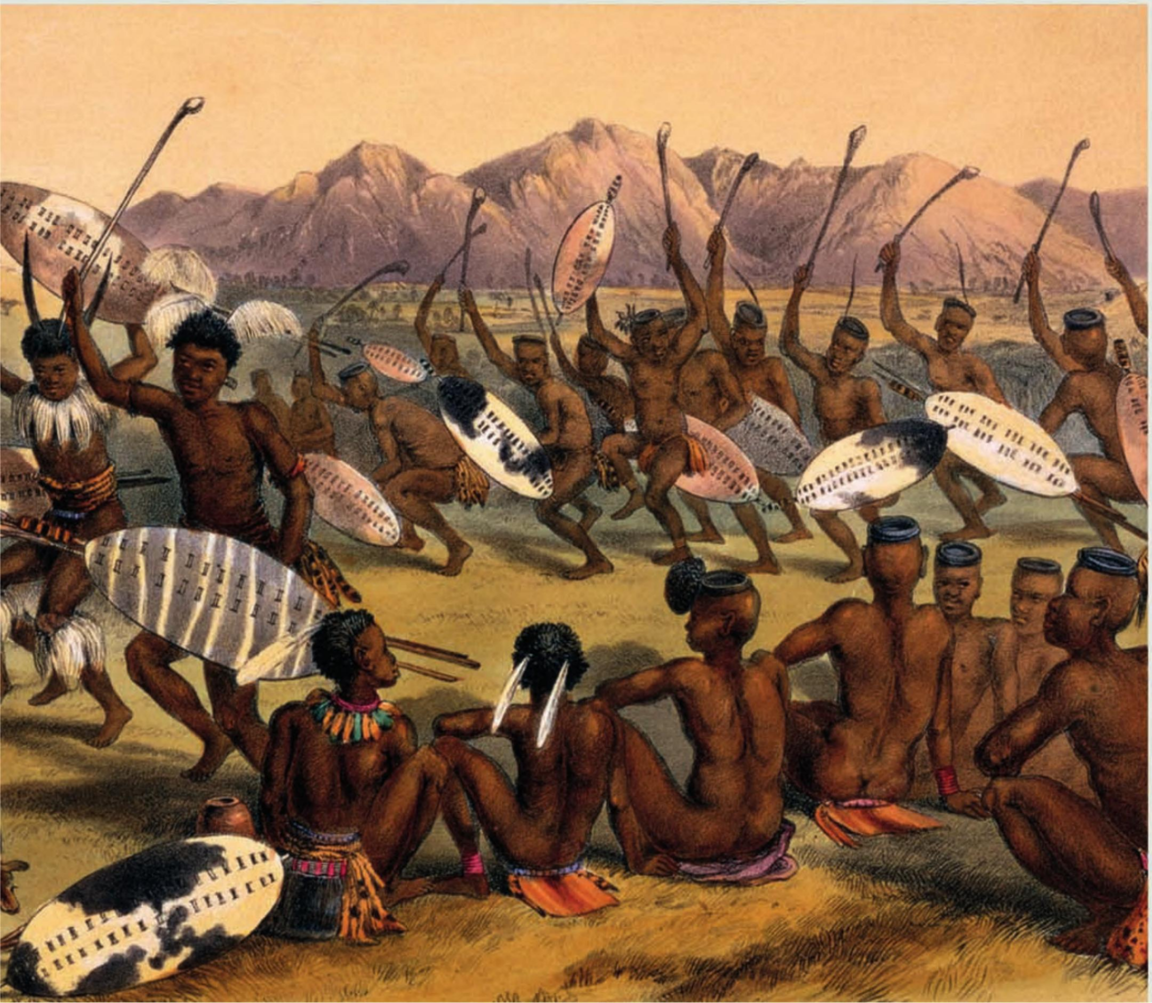
THE BATTLE OF ADOWA

1896

Ethiopia was the only African state to retain full independence in the imperialist era. In March 1896, an Italian army invaded Ethiopia from Eritrea, launching an ill-planned attack on King Menelik II's army at Adowa. Losing their cohesion on difficult terrain, the Italian forces were massacred.

Le Petit Journal
SUPPLÉMENT ILLUSTRÉ
Le Négus Ménélik à la bataille d'Adoua

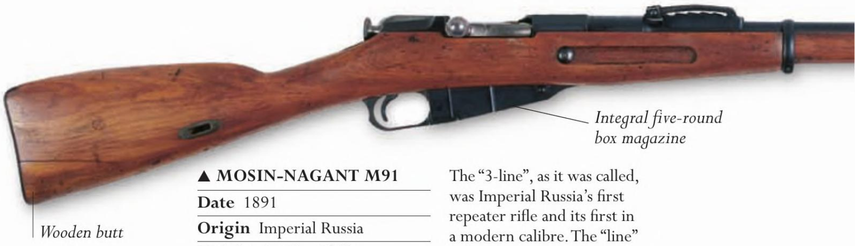
▲ A contemporary French magazine featuring King Menelik II, victor of Adowa, on its cover.



◀ **A ZULU WARRIOR HUNTING DANCE**
The Zulu were a pastoral people in southern Africa. They became a dominant regional power in the early 19th century, through the adoption of a rigorous military organization and effective fighting tactics with the stabbing spear and shield.

MANUALLY LOADED REPEATER RIFLES

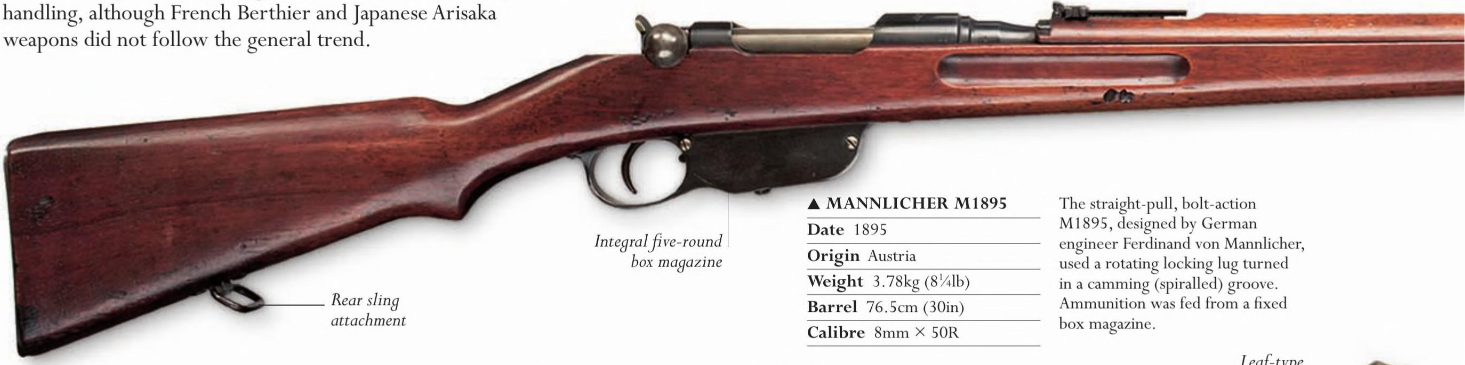
By the 1890s, refinements to the repeater rifle had made it reliable enough for use in many of the world's armies. In Britain, the .303 Lee-Metford was developed into the Lee-Enfield Mark I of 1895, the first in an enduring line of bolt-action rifles, while in Germany, the Mauser Gewehr 98 of 1898 was a near-faultless design. Thereafter, changes in design were made mostly to reduce the weapon's weight, or to cut manufacturing costs. After the turn of the century, the barrel length was often reduced to improve handling, although French Berthier and Japanese Arisaka weapons did not follow the general trend.


Integral five-round box magazine
Wooden butt

▲ MOSIN-NAGANT M91

Date	1891
Origin	Imperial Russia
Weight	4.43kg (9¾lb)
Barrel	80.2cm (31½in)
Calibre	7.62mm × 54R

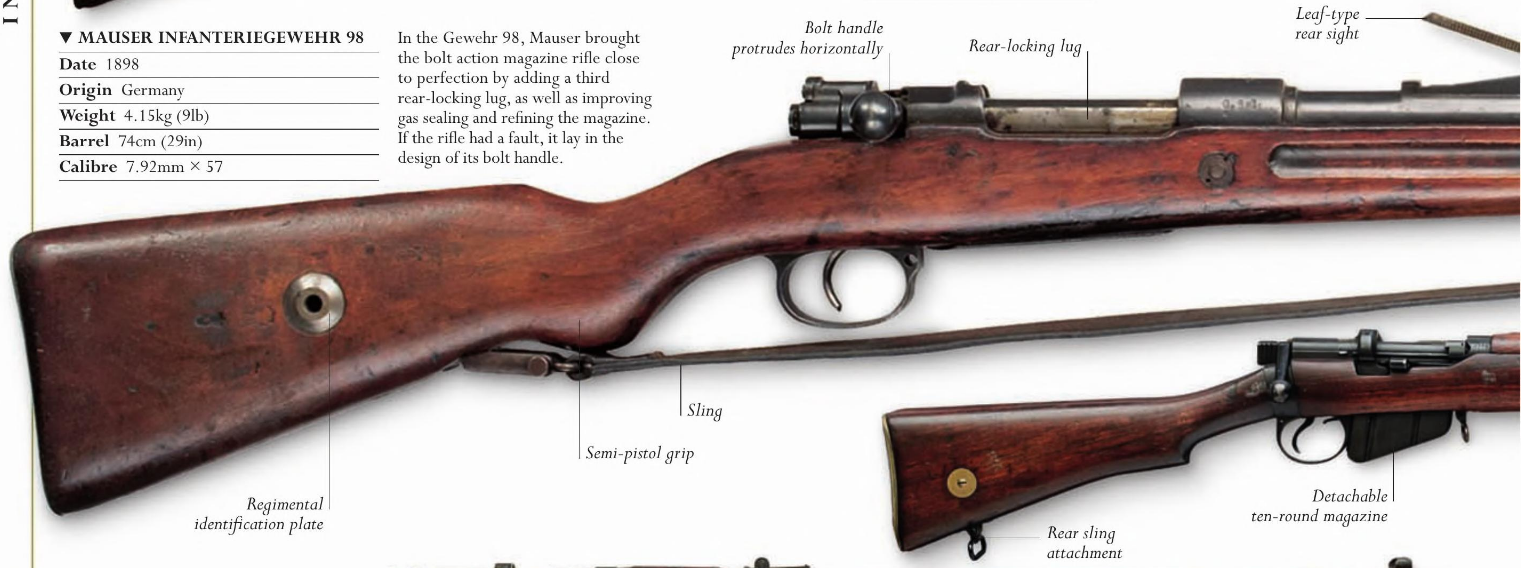
The "3-line", as it was called, was Imperial Russia's first repeater rifle and its first in a modern calibre. The "line" was a measure approximating one-tenth of an inch and refers to its calibre.


Integral five-round box magazine
Rear sling attachment

▲ MANNLICHER M1895

Date	1895
Origin	Austria
Weight	3.78kg (8¼lb)
Barrel	76.5cm (30in)
Calibre	8mm × 50R

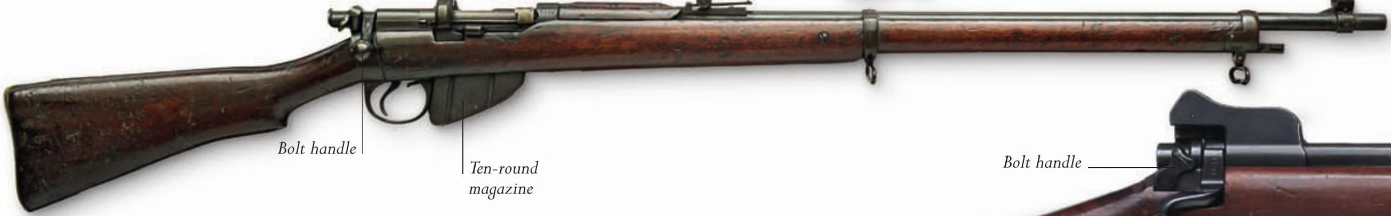
The straight-pull, bolt-action M1895, designed by German engineer Ferdinand von Mannlicher, used a rotating locking lug turned in a camming (spiralled) groove. Ammunition was fed from a fixed box magazine.


Bolt handle protrudes horizontally
Rear-locking lug
Leaf-type rear sight
Sling
Semi-pistol grip
Regimental identification plate
Detachable ten-round magazine
Rear sling attachment

▼ MAUSER INFANTERIEGEWEHR 98

Date	1898
Origin	Germany
Weight	4.15kg (9lb)
Barrel	74cm (29in)
Calibre	7.92mm × 57

In the Gewehr 98, Mauser brought the bolt action magazine rifle close to perfection by adding a third rear-locking lug, as well as improving gas sealing and refining the magazine. If the rifle had a fault, it lay in the design of its bolt handle.

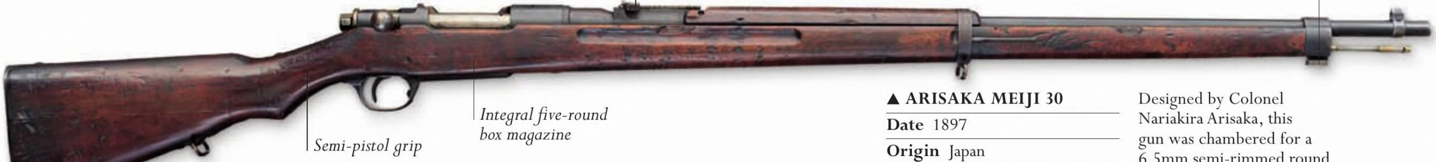

Bolt handle
Ten-round magazine

▲ LEE-ENFIELD MARK I

Date	1895
Origin	UK
Weight	4kg (8¾lb)
Barrel	63.5cm (25in)
Calibre	.303in

A redesigned version of the .303 Lee-Metford of 1888, the ".303 calibre, Rifle, Magazine, Lee-Enfield" – or Mark I – had a detachable ten-round magazine, and, with the bolt handle near the trigger, was faster to operate than the rival Mauser rifle.

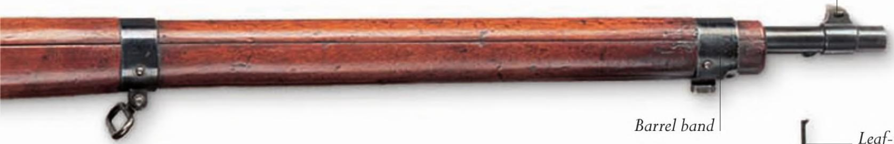
Bolt handle
Wooden butt

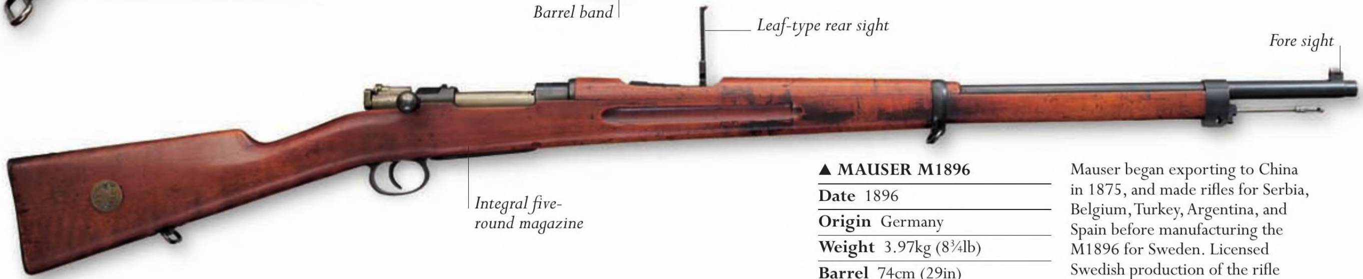

Rear sight
Bayonet lug
Integral five-round box magazine
Semi-pistol grip

▲ ARISAKA MEIJI 30

Date	1897
Origin	Japan
Weight	4.3kg (9½lb)
Barrel	79.8cm (31½in)
Calibre	6.5mm × 50SR

Designed by Colonel Nariakira Arisaka, this gun was chambered for a 6.5mm semi-rimmed round and used a turning bolt of the Mauser pattern with forward-locking lugs.

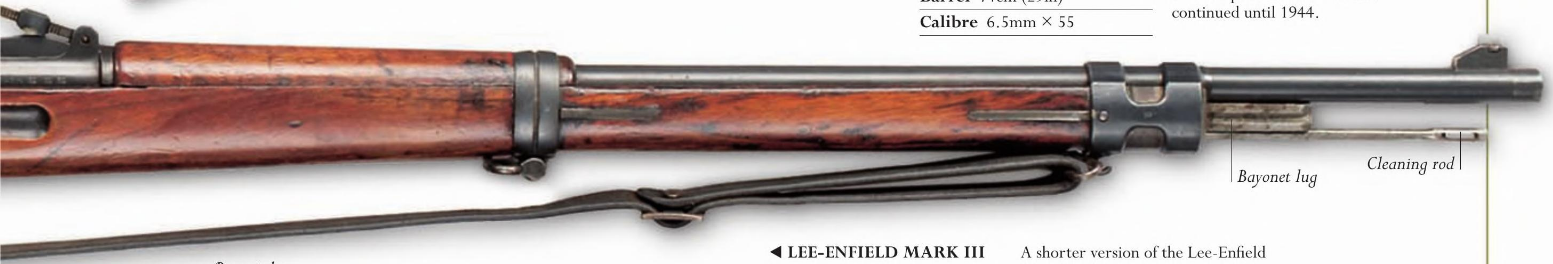

Fore sight
Barrel band

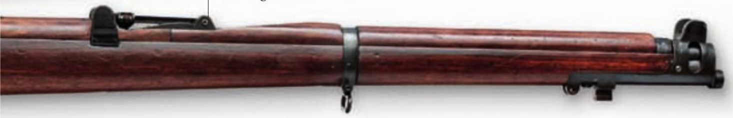

Leaf-type rear sight
Fore sight
Integral five-round magazine

▲ MAUSER M1896

Date	1896
Origin	Germany
Weight	3.97kg (8¾lb)
Barrel	74cm (29in)
Calibre	6.5mm × 55

Mauser began exporting to China in 1875, and made rifles for Serbia, Belgium, Turkey, Argentina, and Spain before manufacturing the M1896 for Sweden. Licensed Swedish production of the rifle continued until 1944.

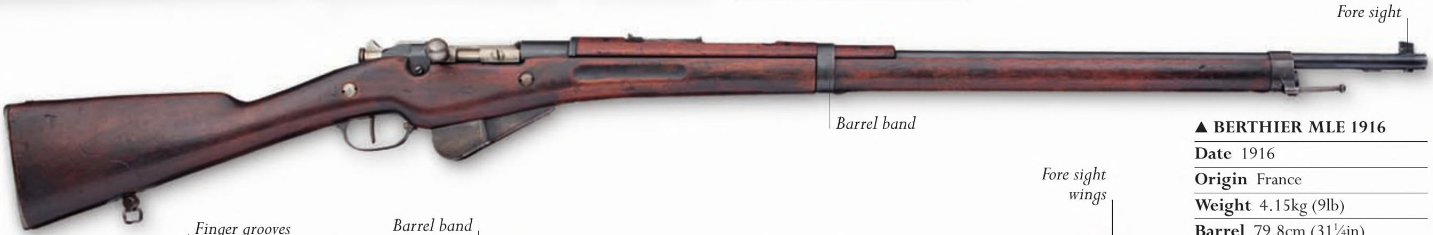

Bayonet lug
Cleaning rod



◀ LEE-ENFIELD MARK III

Date	1907
Origin	UK
Weight	3.96kg (8¾lb)
Barrel	64cm (25in)
Calibre	.303in

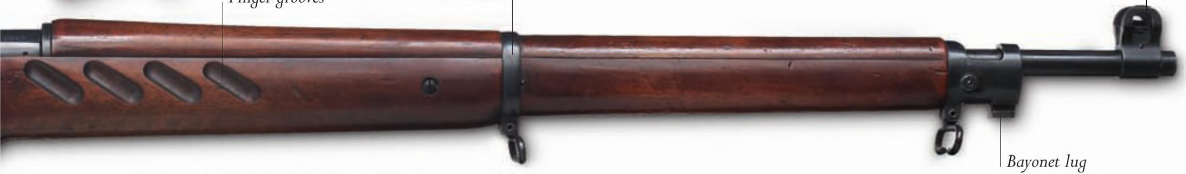
A shorter version of the Lee-Enfield Mark I had been introduced in 1904 as the Short Magazine Lee-Enfield (SMLE, often nicknamed "Smellie"). The SMLE Mark III introduced improvements to the rear sight, magazine, and chamber.


Fore sight
Barrel band

▲ BERTHIER MLE 1916

Date	1916
Origin	France
Weight	4.15kg (9lb)
Barrel	79.8cm (31¼in)
Calibre	8mm × 50R

A modified version of the 1902 model Berthier rifle, this gun had a five-round magazine in place of the original's three-round magazine. The piling hook below the fore sight was used to stack the rifles "teepee-style" when troops were encamped.


Finger grooves
Barrel band
Fore sight wings
Bayonet lug

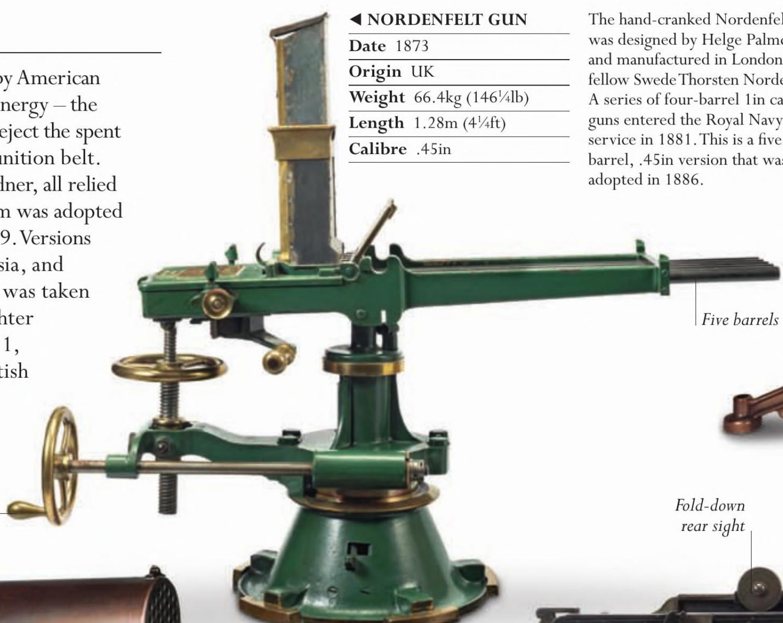
▲ ENFIELD PATTERN 1913

Date	1913
Origin	UK
Weight	3.9kg (8½lb)
Barrel	66cm (26in)
Calibre	.276in

This experimental design was produced as a potential replacement for the Lee-Enfield SMLE, firing a more powerful 7mm round. After trials in 1913, the experiment was abandoned due to the onset of World War I.

MACHINE-GUNS

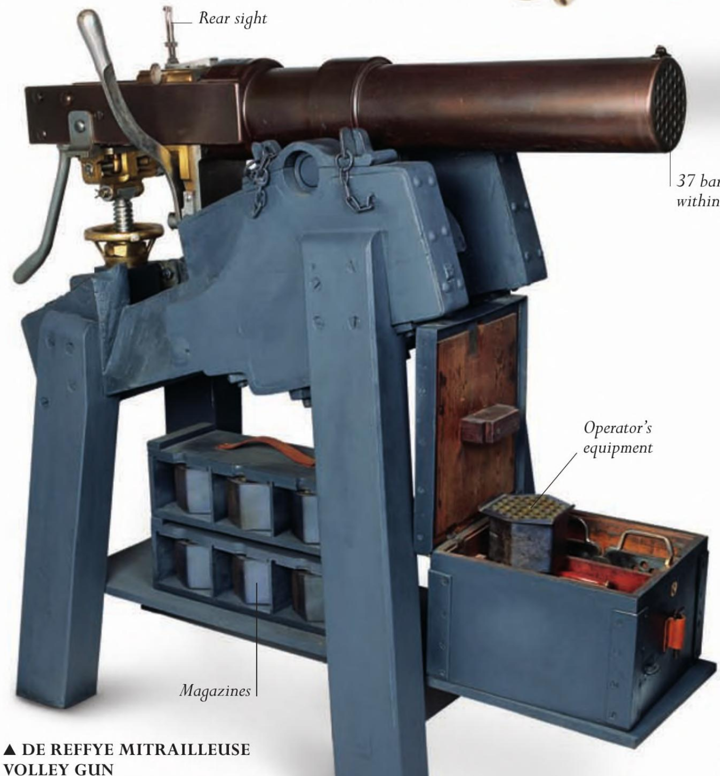
The first self-powered machine-gun was developed by American Hiram Maxim in Britain in 1884. In that design, the recoil energy – the backwards force created by firing a cartridge – was used to eject the spent cartridge and then load and fire a new one from the ammunition belt. Earlier rapid-fire guns, such as the Nordenfelt and the Gardner, all relied on an operator for turning a hand-cranked lever. The Maxim was adopted in Austria and Italy in 1887, and by the British Army in 1889. Versions of the gun were manufactured in the US, Germany, Russia, and Switzerland from 1904–11. In 1896, Maxim's company was taken over by the British firm Vickers, and their improved, lighter versions of the weapon – in particular the enduring Mk 1, launched in 1912 – were to remain in service in the British Army through two world wars and beyond.



◀ NORDENFELT GUN

Date	1873
Origin	UK
Weight	66.4kg (146¼lb)
Length	1.28m (4¼ft)
Calibre	.45in

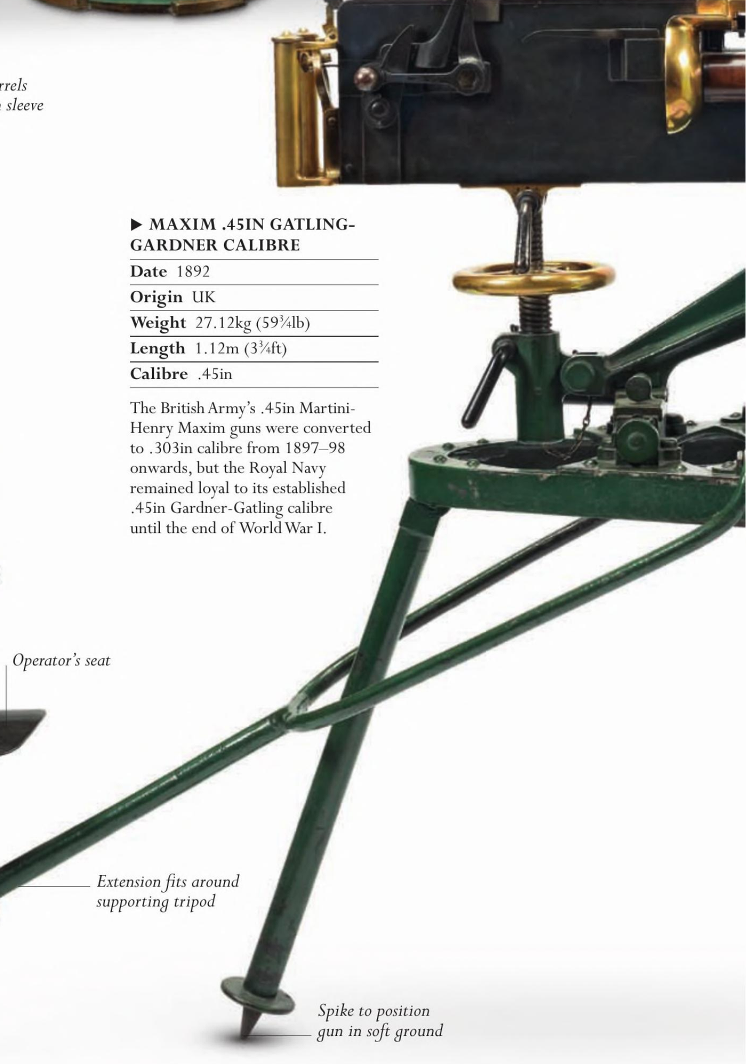
The hand-cranked Nordenfelt was designed by Helge Palmcrantz and manufactured in London by fellow Swede Thorsten Nordenfelt. A series of four-barrel 1in calibre guns entered the Royal Navy service in 1881. This is a five-barrel, .45in version that was adopted in 1886.



▲ DE REFFYE MITRAILLEUSE VOLLEY GUN

Date	1869
Origin	France
Weight	340kg (749½lb)
Length	1.76m (5¾ft)
Calibre	13mm

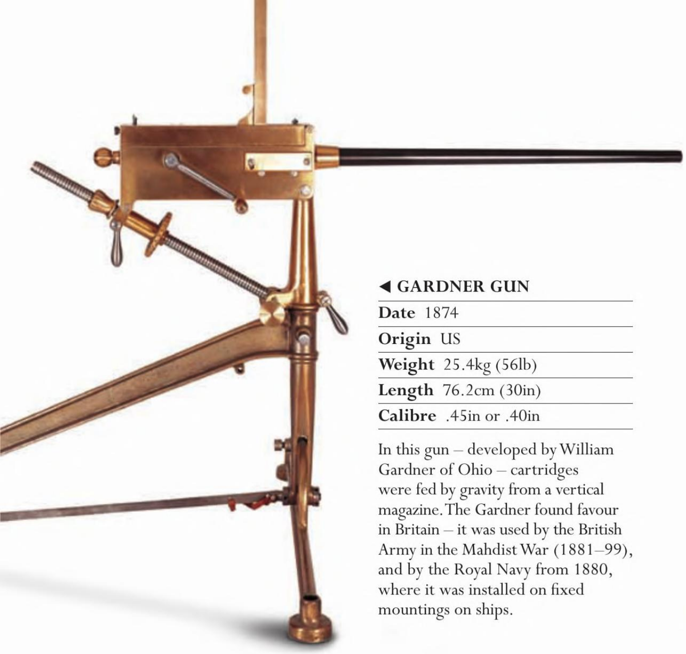
Developed by Joseph Montigny of Belgium, and improved by French ordnance engineer Commandant de Reffye, this gun was used in the Franco-Prussian War (1870–71). The original was a 25-barrel weapon, while this is a 37-barrel modification. In combat, the Mitrailleuse would be mounted on a wheeled carriage.


Fold-down rear sight
Operator's seat
Extension fits around supporting tripod
Spike to position gun in soft ground

▶ MAXIM .45IN GATLING-GARDNER CALIBRE

Date	1892
Origin	UK
Weight	27.12kg (59¾lb)
Length	1.12m (3¾ft)
Calibre	.45in

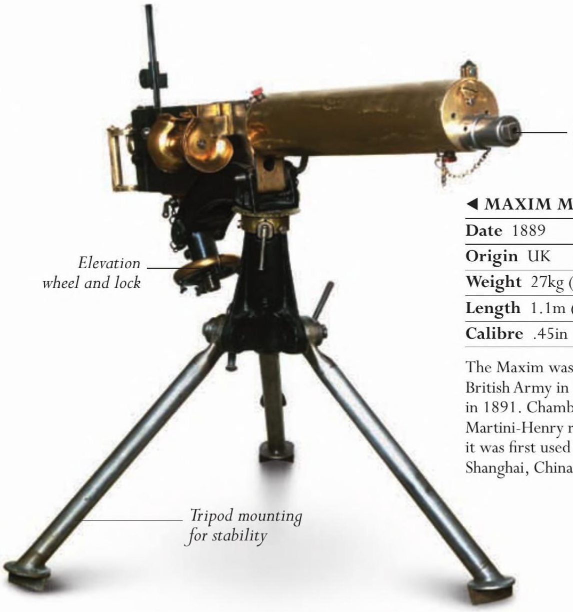
The British Army's .45in Martini-Henry Maxim guns were converted to .303in calibre from 1897–98 onwards, but the Royal Navy remained loyal to its established .45in Gardner-Gatling calibre until the end of World War I.



◀ GARDNER GUN

Date	1874
Origin	US
Weight	25.4kg (56lb)
Length	76.2cm (30in)
Calibre	.45in or .40in

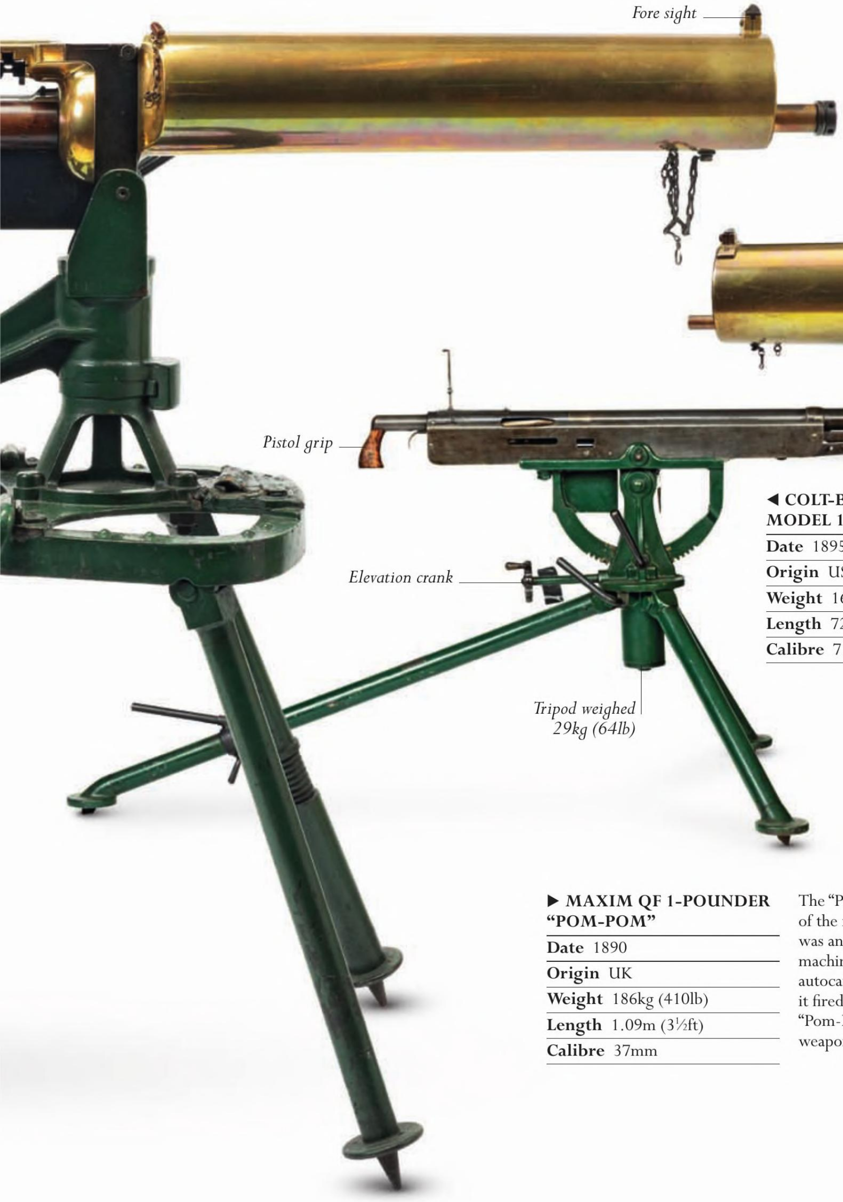
In this gun – developed by William Gardner of Ohio – cartridges were fed by gravity from a vertical magazine. The Gardner found favour in Britain – it was used by the British Army in the Mahdist War (1881–99), and by the Royal Navy from 1880, where it was installed on fixed mountings on ships.

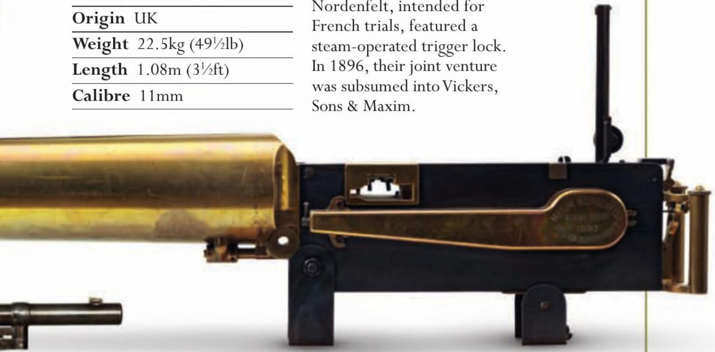


◀ MAXIM MACHINE-GUN

Date	1889
Origin	UK
Weight	27kg (59½lb)
Length	1.1m (3½ft)
Calibre	.45in

The Maxim was approved for the British Army in 1889 and issued in 1891. Chambered for the .45in Martini-Henry rifle ammunition, it was first used in combat near Shanghai, China, in 1893.





▼ MAXIM-NORDENFELT MODEL 1893

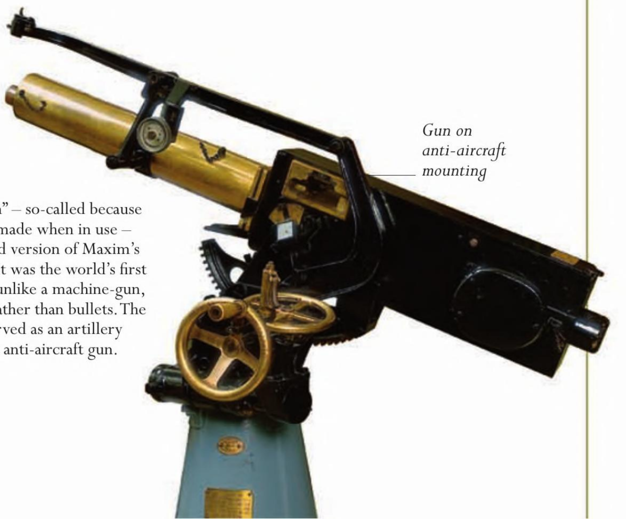
Date	1893
Origin	UK
Weight	22.5kg (49½lb)
Length	1.08m (3½ft)
Calibre	11mm

Maxim and Nordenfelt entered into partnership in 1888. This 11mm Maxim-Nordenfelt, intended for French trials, featured a steam-operated trigger lock. In 1896, their joint venture was subsumed into Vickers, Sons & Maxim.

◀ COLT-BROWNING MODEL 1895

Date	1895
Origin	US
Weight	16.8kg (37lb)
Length	72cm (28¼in)
Calibre	7.65mm

This air-cooled, gas-operated Colt-Browning 1895 had a swinging arm that descended vertically beneath the barrel when the gun was firing, earning it the nickname "the potato digger". This gun could fire 400–500 rounds per minute.



▶ MAXIM QF 1-POUNDER "POM-POM"

Date	1890
Origin	UK
Weight	186kg (410lb)
Length	1.09m (3½ft)
Calibre	37mm

The "Pom-Pom" – so-called because of the noise it made when in use – was an enlarged version of Maxim's machine-gun. It was the world's first autocannon – unlike a machine-gun, it fired shells rather than bullets. The "Pom-Pom" served as an artillery weapon and an anti-aircraft gun.

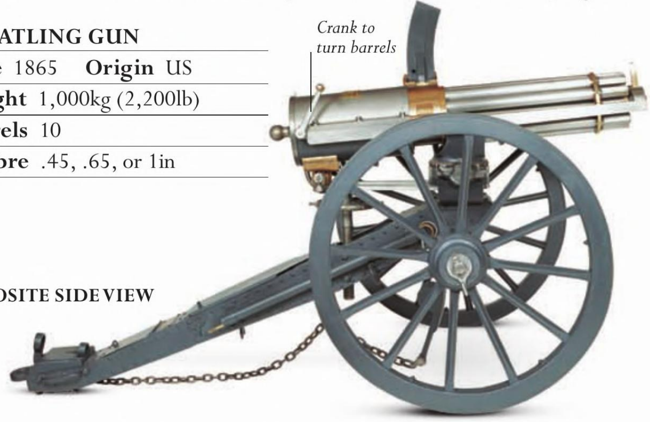
A NEW KIND OF FIREPOWER

GATLING GUN

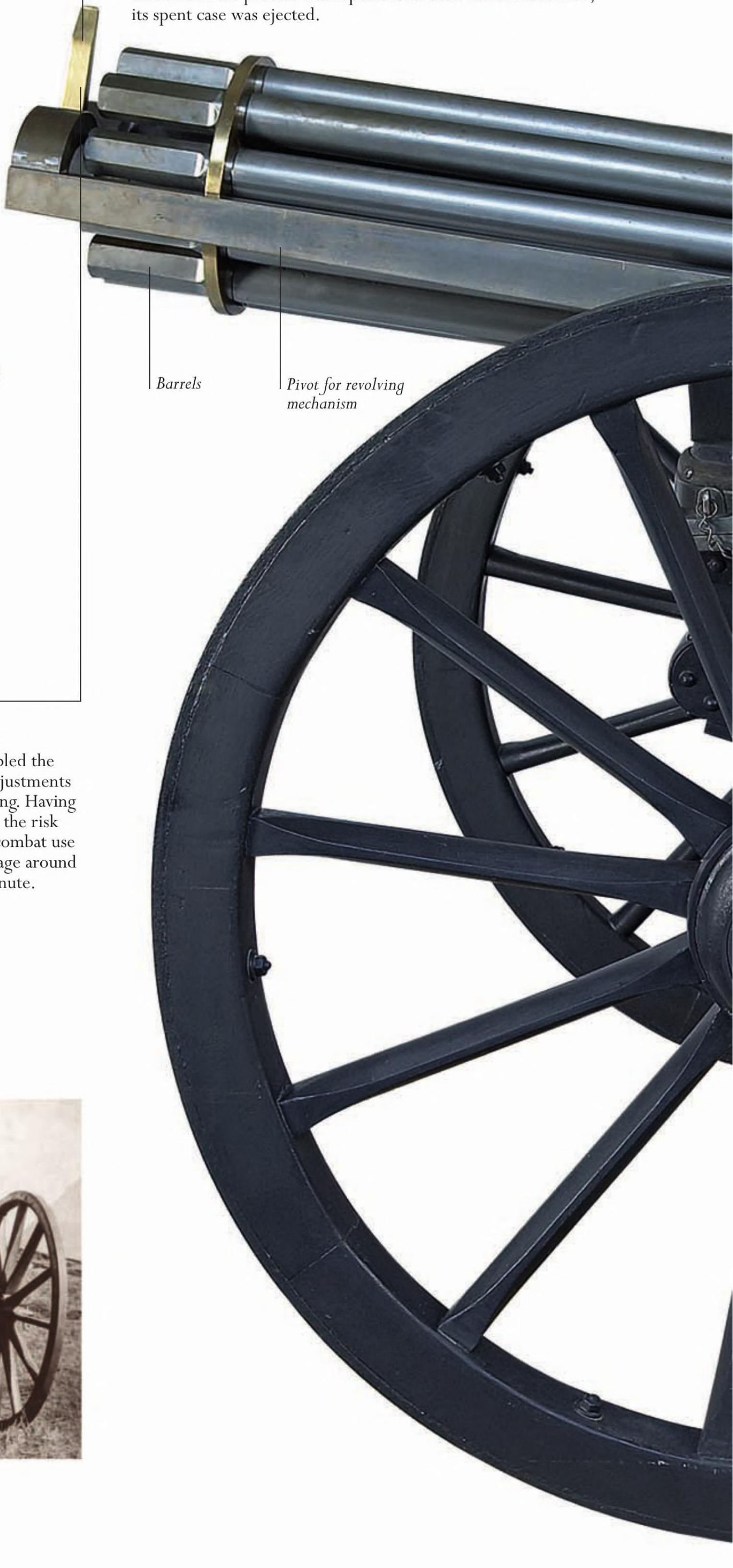
By the second half of the 19th century, improvements in engineering had made it possible to manufacture reliable multiple-fire weapons. This gun, patented by Richard Gatling in 1862, employed multiple barrels, as would all early machine guns. It also took advantage of the new brass cartridge – earlier paper cartridges were dangerous, being liable to combust unpredictably. The Gatling gun was first developed in the American Civil War, and was deemed a success. It subsequently saw action with the British Army in various overseas campaigns.

▶ GATLING GUN

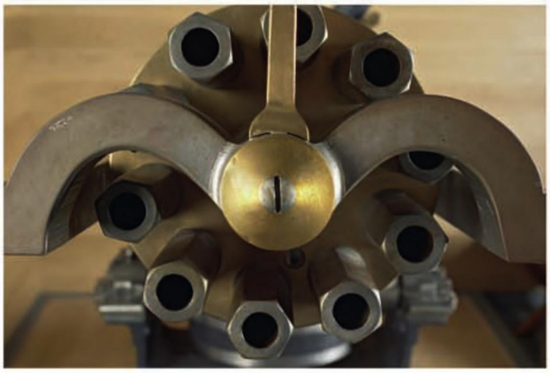
Date	1865	**Origin**	US
Weight	1,000kg (2,200lb)		
Barrels	10		
Calibre	.45, .65, or 1in		



OPPOSITE SIDE VIEW



THE GATLING GUN
The gun's barrels – at first six, later ten – were arranged around a cylindrical shaft. A hand-operated crank made the barrels revolve, and cartridges dropped into place from above as each barrel came around. A firing pin then struck and fired the bullet; the barrel turned and the process was repeated. As each barrel descended, its spent case was ejected.



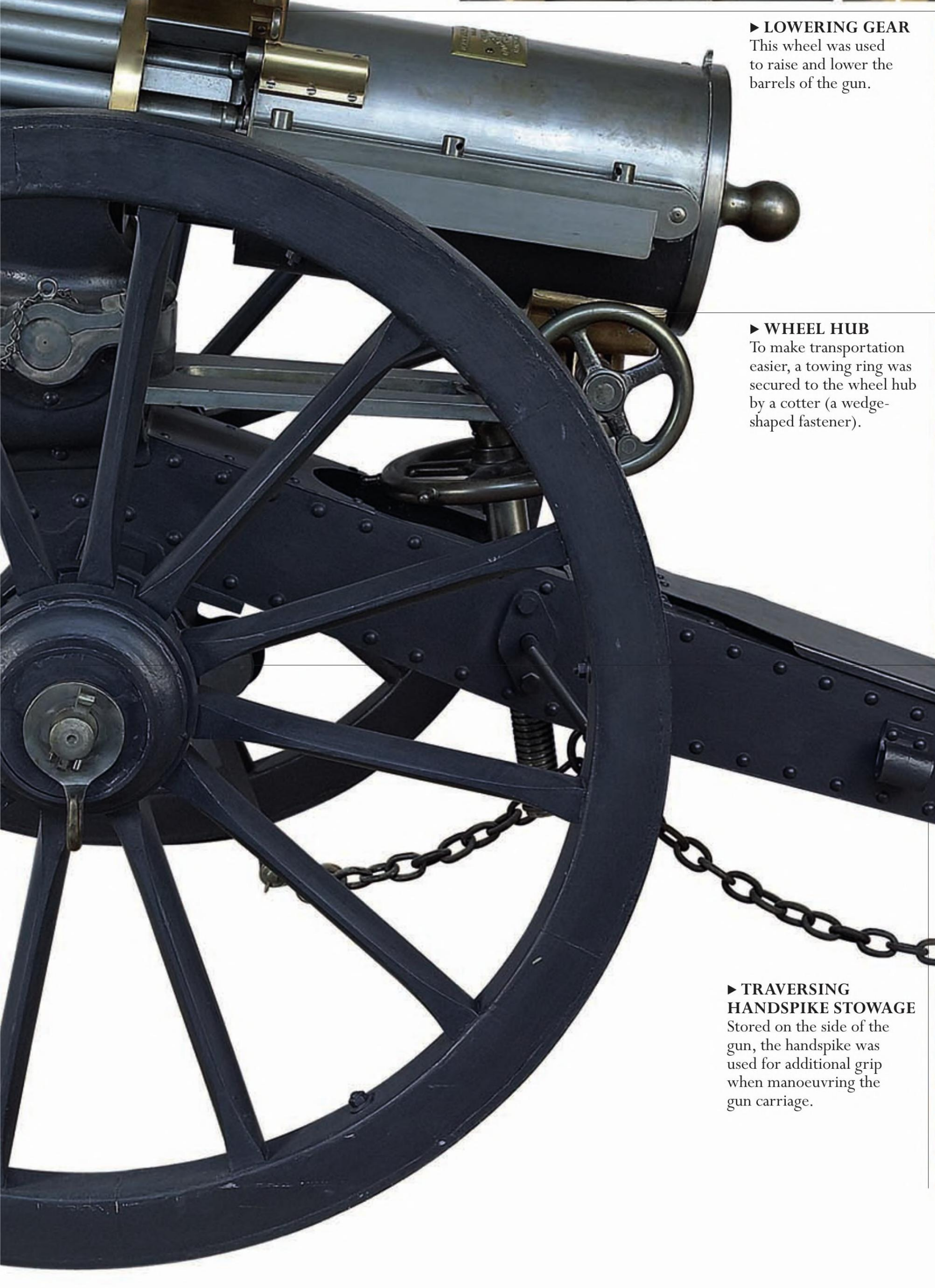
◀ FORE SIGHT AND BARRELS
The fore sight enabled the gunner to make adjustments to the gun's targeting. Having 10 barrels reduced the risk of overheating. In combat use the gun could average around 400 rounds per minute.

IN ACTION

ON THE BATTLEFIELD

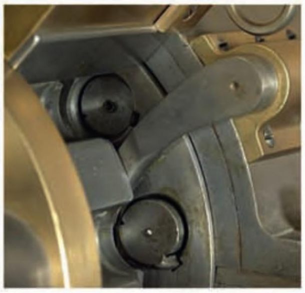
The Gatling gun's method of operation enabled unskilled users to maintain a reasonably high rate of fire. This had its most notable effect in colonial wars against adversaries with less advanced arms, such as its use against the Plains Indians in North America, by the US Army, and against the Zulus in southern Africa, by the British Army. Some of the guns were also used as naval weapons, though with a slightly reduced rate of fire.

▶ The British Army used the Gatling to devastating effect in the Zulu Wars.



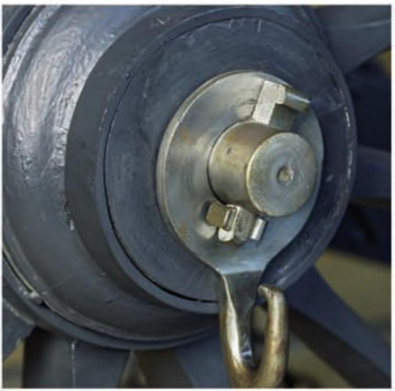
▸ **ANTI-ROTATION PAWL** The breech plugs contain firing pins; each pin has a small cam head to catch hold of the gun body.

◂ **MAGAZINE SLOT** The 40-round magazine was constructed with a groove to help prevent the gun jamming.



▸ **LOWERING GEAR** This wheel was used to raise and lower the barrels of the gun.

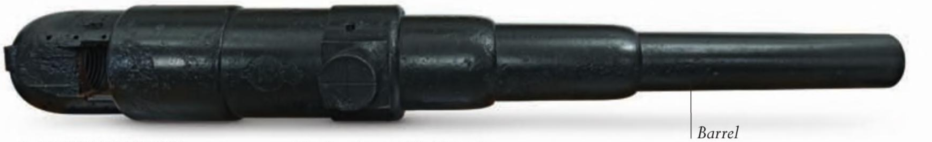
▸ **WHEEL HUB** To make transportation easier, a towing ring was secured to the wheel hub by a cotter (a wedge-shaped fastener).



▸ **TRAVERSING HANDSPIKE STOWAGE** Stored on the side of the gun, the handspike was used for additional grip when manoeuvring the gun carriage.

BREECH-LOADING ARTILLERY

British engineer William Armstrong designed the first efficient breech-loading rifled field gun in 1855. The shell and gunpowder propellant were loaded at the breech, which was closed with a "vent-piece" secured in a slot with a hollow screw. Armstrong's 12-pounder gun, of 1859, was the first rifled breech-loading field gun to enter British Army service, and the Armstrong RBL 40-pounder was an adaptation of this gun as a medium artillery piece. The French Canon de 75mm Modèle 1897 added a key element to artillery design – a recoil-dampening mechanism that kept the trail and wheels perfectly still when firing, which freed gun crews from having to re-aim the gun after each shot.



▲ ARMSTRONG RBL 40-POUND GUN

Date 1861

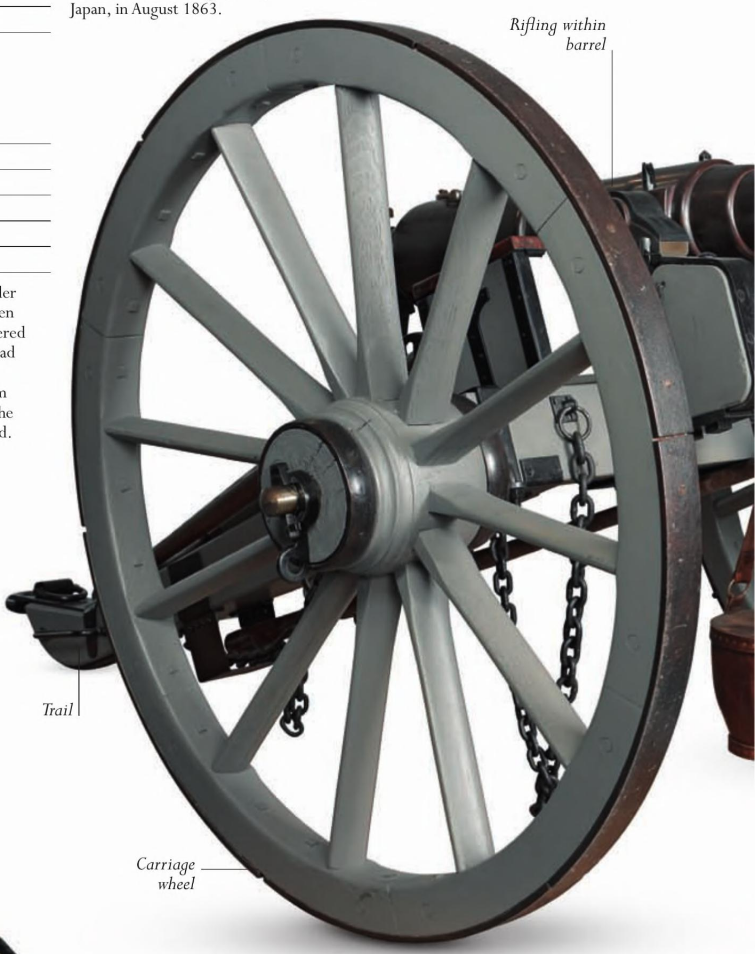
Origin UK

Length 3m (9¾ft)

Calibre 12cm

Range 2.56km (1.59 miles)

The Armstrong rifled breech-loading 40-pounder was used by the British Royal Navy as a broadside gun, and by the army as a defensive gun in military forts. It saw action in the Royal Navy's bombardment of Kagoshima, Japan, in August 1863.



▶ ARMSTRONG RBL 12-POUNDER

Date 1859

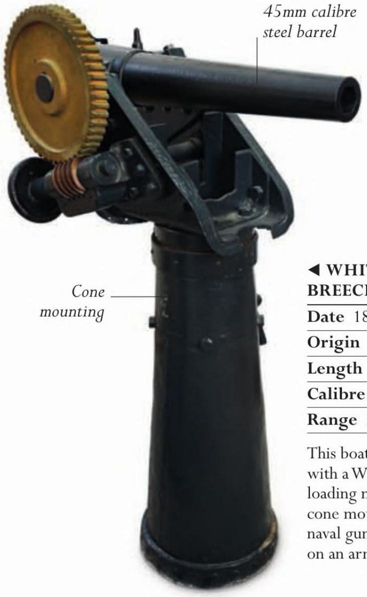
Origin UK

Length 2.13m (7ft)

Calibre 7.62cm

Range 3.1km (1.92 miles)

The Armstrong rifled 12-pounder gun required a crew of nine men to operate it. The gun that entered British Army service in 1859 had a 2.13m (7ft) barrel, while the British Royal Navy used a 1.83m (6ft) barrel version. In 1863, the shorter version became standard.



◀ WHITWORTH 45MM BREECH-LOADING BOAT GUN

Date 1875

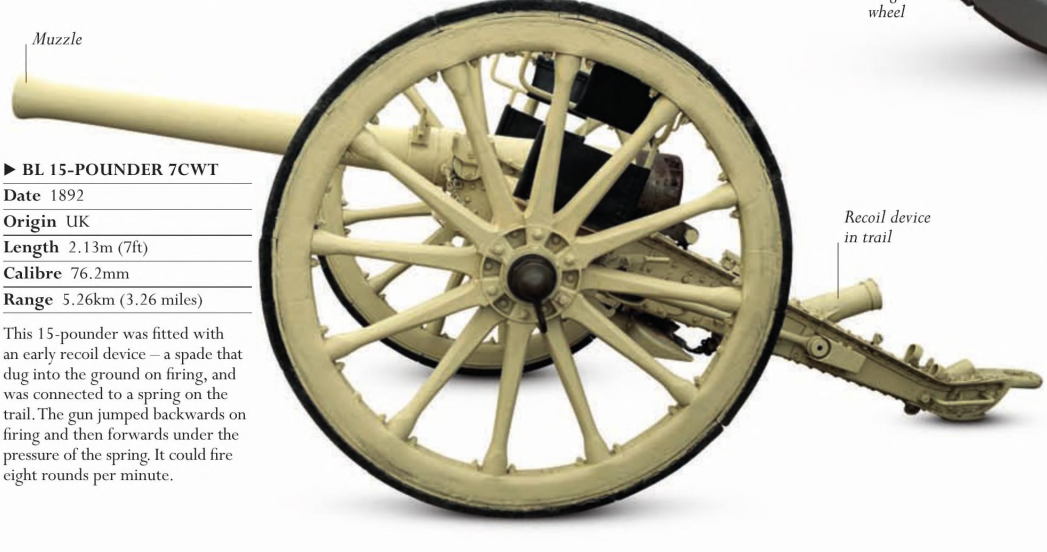
Origin UK

Length 94cm (37in)

Calibre 45mm

Range 360m (393¾ yards)

This boat gun had hexagonal rifling with a Whitworth sliding-lock breech-loading mechanism. It was set on a cone mounting mostly used for small naval guns. This example was mounted on an armed yacht.



▶ BL 15-POUNDER 7CWT

Date 1892

Origin UK

Length 2.13m (7ft)

Calibre 76.2mm

Range 5.26km (3.26 miles)

This 15-pounder was fitted with an early recoil device – a spade that dug into the ground on firing, and was connected to a spring on the trail. The gun jumped backwards on firing and then forwards under the pressure of the spring. It could fire eight rounds per minute.

▶ HOTCHKISS QUICK-FIRING 3-POUNDER NAVAL GUN

Date 1885

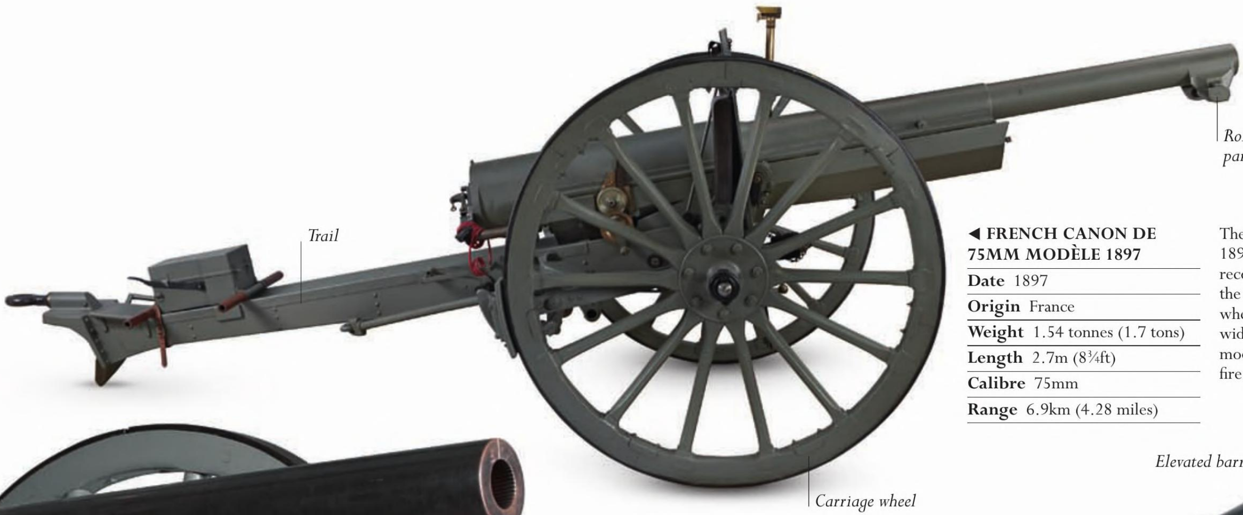
Origin France

Length (Barrel) 2m (6½ft)

Calibre 47mm

Range 3.66km (2.27 miles)

The Hotchkiss QF (Quick-Firing) 3-pounder was used by the British Royal Navy from 1885, as well as the French, Russian, and US navies. These guns were made by a division of the Armstrong armaments business. Operated by two men, the gun could fire up to thirty 1.5kg (3¼lb) steel shells per minute.

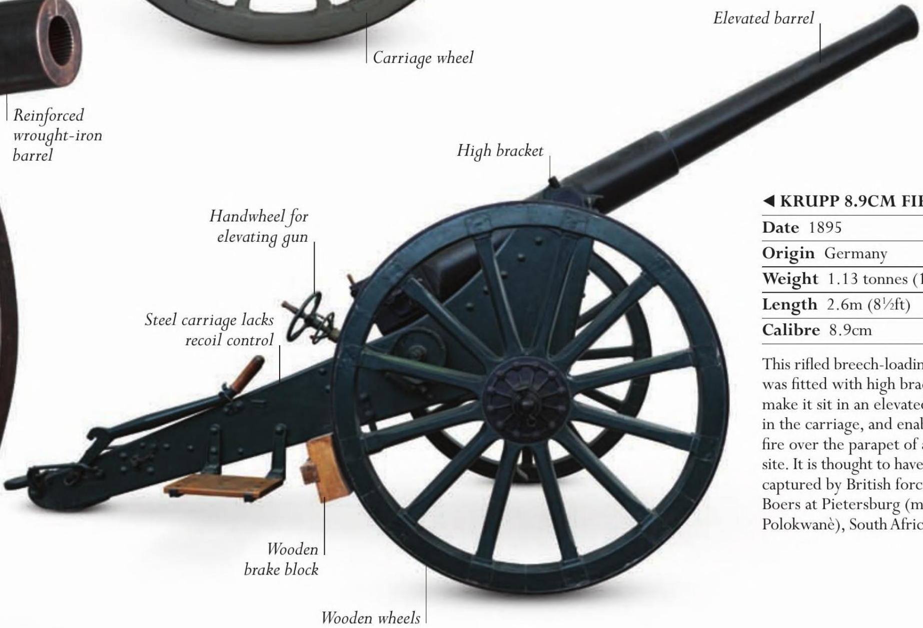

Rollers at muzzle, part of recoil device
Trail
Carriage wheel

◀ FRENCH CANON DE 75MM MODÈLE 1897

Date	1897
Origin	France
Weight	1.54 tonnes (1.7 tons)
Length	2.7m (8¾ft)
Calibre	75mm
Range	6.9km (4.28 miles)

The Canon de 75mm Modèle 1897 used a hydro-pneumatic recoil mechanism that kept the trail and wheels stationary when firing, making the model widely regarded as the first modern artillery gun. It could fire 15 rounds per minute.

Reinforced wrought-iron barrel


Elevated barrel
High bracket
Handwheel for elevating gun
Steel carriage lacks recoil control
Wooden brake block
Wooden wheels

◀ KRUPP 8.9CM FIELD GUN

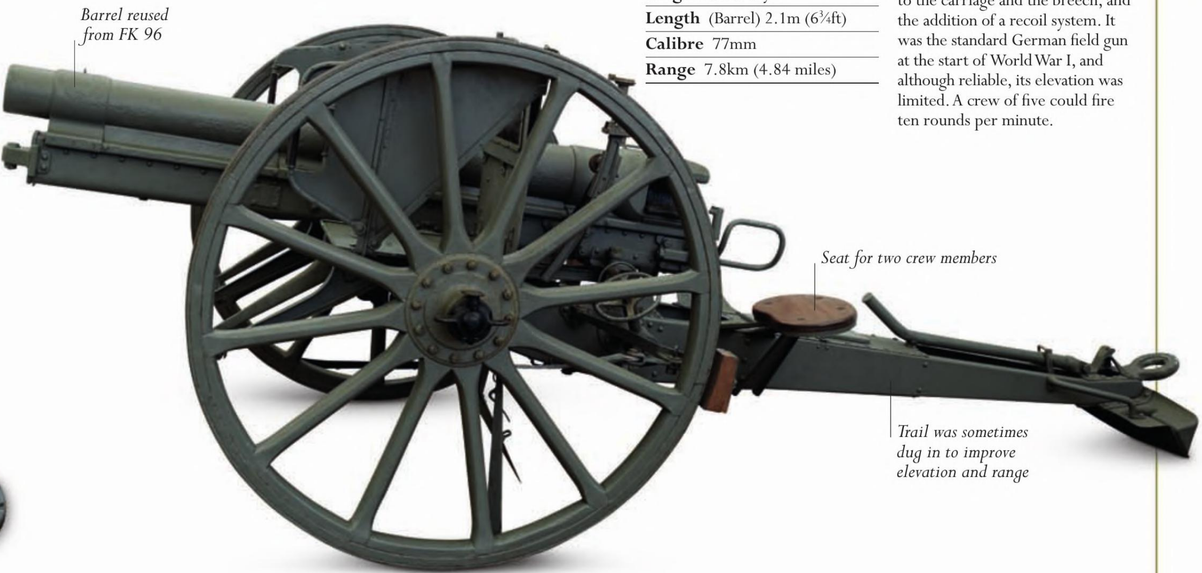
Date	1895
Origin	Germany
Weight	1.13 tonnes (1.25 tons)
Length	2.6m (8½ft)
Calibre	8.9cm

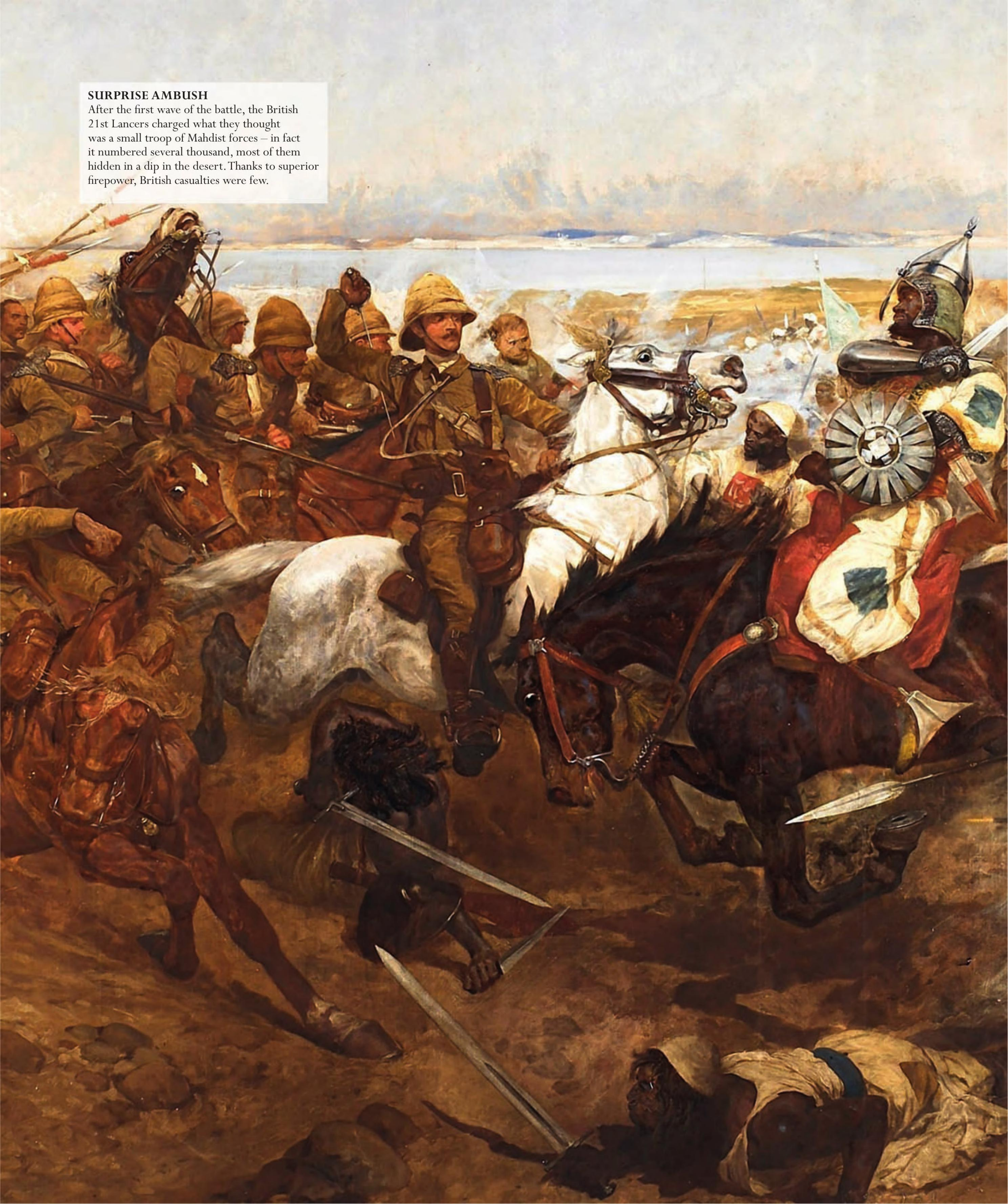
This rifled breech-loading field gun was fitted with high brackets to make it sit in an elevated position in the carriage, and enable it to fire over the parapet of a fortified site. It is thought to have been captured by British forces from Boers at Pietersburg (modern-day Polokwanè), South Africa, in 1901.

▼ 7.7CM FK 96 NA

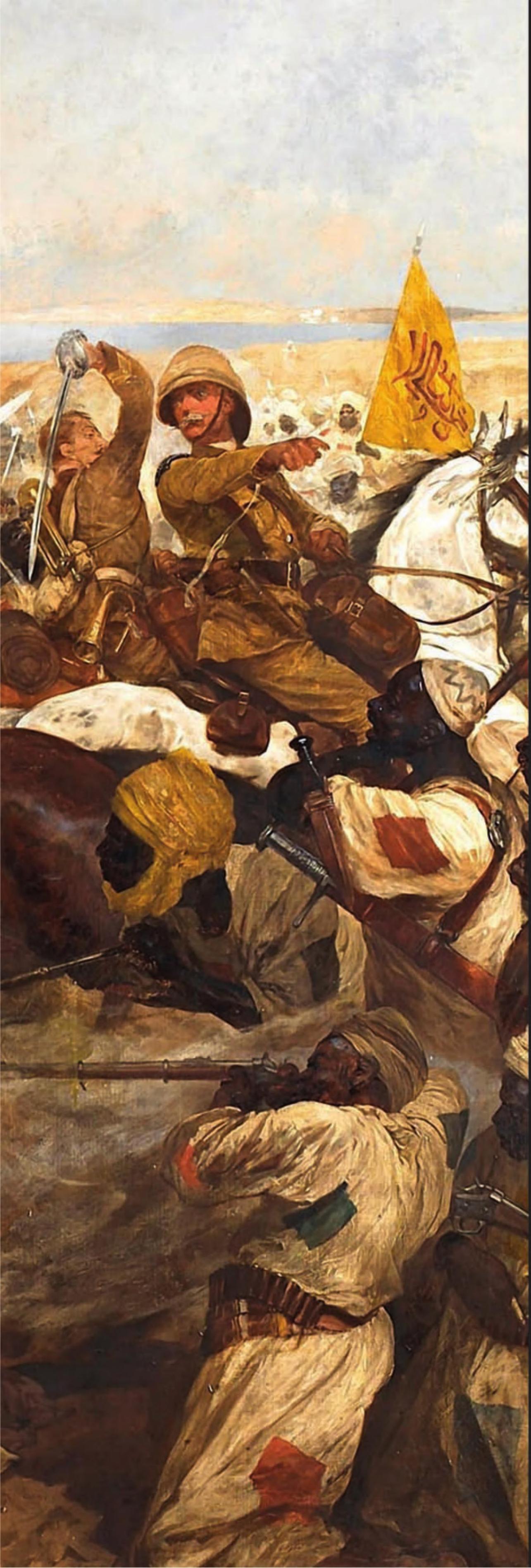
Date	1905
Origin	Germany
Length	(Barrel) 2.1m (6¾ft)
Calibre	77mm
Range	7.8km (4.84 miles)

The 7.7cm Feldkanone 96 neuer Art was an upgraded version of the FK 96, featuring improvements to the carriage and the breech, and the addition of a recoil system. It was the standard German field gun at the start of World War I, and although reliable, its elevation was limited. A crew of five could fire ten rounds per minute.


Barrel reused from FK 96
Seat for two crew members
Trail was sometimes dug in to improve elevation and range



SURPRISE AMBUSH
After the first wave of the battle, the British 21st Lancers charged what they thought was a small troop of Mahdist forces – in fact it numbered several thousand, most of them hidden in a dip in the desert. Thanks to superior firepower, British casualties were few.



IMPERIAL FIREPOWER

THE BATTLE OF OMDURMAN

The battle fought between General Herbert Kitchener's Anglo-Egyptian army and the Muslim Mahdists at Omdurman, in Sudan on 2 September 1898, was an overwhelming victory for European industrial technology over a determined African army of superior numbers but limited firepower.

As *Sirdar* (commander-in-chief) of the British-officered Egyptian army, Kitchener was entrusted with avenging the death of General Gordon at the hands of Sudanese Mahdists. The Mahdists were in revolt against British-supported Egyptian rule, and had killed Gordon in 1885 at Khartoum; tactically, Britain also wanted to deter the ambitions of the rival French in Sudan.

Kitchener's army of 8,000 British and 18,000 Egyptian troops advanced down the Nile, accompanied by river gunboats carrying supplies and heavy equipment and providing extra firepower. The land forces were equipped with field artillery as well as 40 Maxim guns, each capable of firing 600 rounds per minute. The infantry, meanwhile, carried the latest Lee Metford and Lee Enfield rifles, rapid-fire bolt-action weapons with box magazines. Some of the riverborne guns were also provided with shells containing Lyddite, a new high explosive that would later be used in World War I.

The Mahdist leader Khalifa Abdullah al-Taashi waited at Omdurman, near Khartoum. About one third of his army of over 50,000 men had rifles, though often without adequate or appropriate ammunition. The rest relied on spears and swords, still perfectly serviceable weapons at a time when European infantry still practiced the bayonet charge.

On 1 September British cavalry scouts made contact with the Mahdist army. Kitchener took up a defensive position on the bank of the Nile, with his infantry in the centre and cavalry on the flanks. At dawn the following day some 8,000 Mahdist warriors, dressed in white and flourishing banners, made a frontal assault on the defensive perimeter. Their charge across the open plain was met by the fire of field artillery and gunboats and then, as they drew closer, of Maxim guns and rifles. As infantry were to find during the carnage of World War I, an advance into such density of fire from these new weapons was near-suicidal. Not a single warrior reached the defensive line.

RIFLES AND DISCIPLINE

The majority of the Mahdist forces, however, remained in concealed positions around the Anglo-Egyptian camp. When Kitchener's troops left their defensive perimeter and advanced over the body-strewn ground towards Omdurman, they entered a trap. The 21st Lancers, with young war correspondent Winston Churchill in their ranks, inadvertently rode into the midst of several thousand Mahdists hidden in a dry streambed, and suffered 61 casualties. Potentially more serious was the fate of General Hector Macdonald's infantry brigade, caught in the open by some 15,000 Mahdists emerging from hiding, but the 3,000-strong brigade held off the attackers with disciplined rifle fire until reinforcements arrived.

Kitchener's forces advanced relentlessly on Omdurman while it was bombarded with Lyddite shells. By the end of the day the remnants of the Mahdist army had withdrawn, and the town was in British hands. Around 10,000 Mahdists died, compared with only 48 Anglo-Egyptian troops – a striking display of the killing power of European military technology.

CLOTHING AND WEAPONS OF AFRICA AND OCEANIA

By the late 19th century, European invaders were firmly established in Africa and the Pacific Basin. Except in the settlements themselves, their presence actually impinged little on the day-to-day lives of the indigenous peoples, who continued to behave much as they had done for centuries. In particular, while firearms sometimes found their way to the indigenous population, the weapons and tactics they used when fighting among themselves remained largely unchanged. This often had horrific consequences when the native warriors tried to resist conquest. Occasionally, however, as at Isandlwana in 1879 when the Zulus defeated the British, superiority in numbers combined with complacency on the part of the imperialists allowed native warriors using traditional weapons to inflict a crushing defeat.

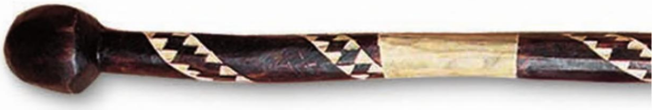
▼ ZULU KNOBKERRIE

Date 19th century

Origin South Africa

Length 91cm (36in)

Knobkerries were simple hardwood rods with round finials, usually around 10cm (4in) in diameter. Clubs such as these were carried by Zulu warriors together with a short-shafted stabbing spear and stiff cowhide shield.



Hardwood shaft

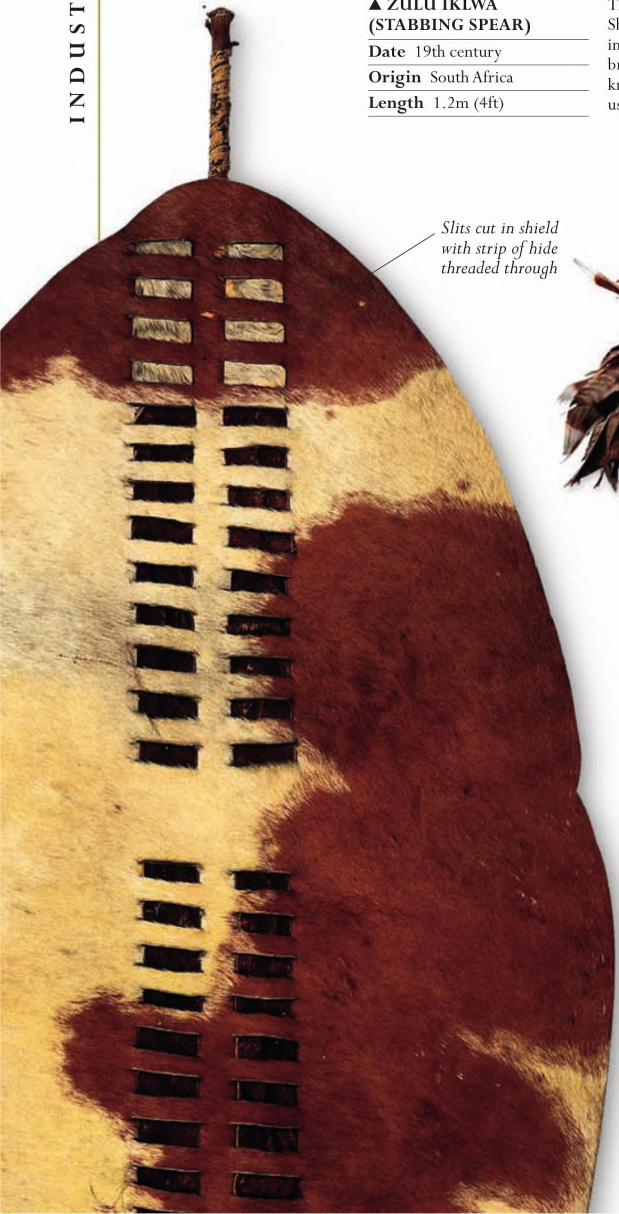
▲ ZULU IKLWA (STABBING SPEAR)

Date 19th century

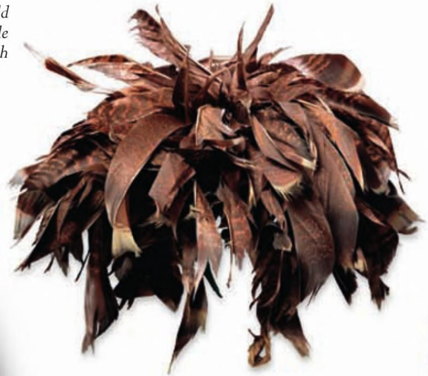
Origin South Africa

Length 1.2m (4ft)

The celebrated Zulu king Shaka was responsible for introducing the short, broad-pointed stabbing spear known as the *iklwa*, which was used along with a shield.



Slits cut in shield with strip of hide threaded through



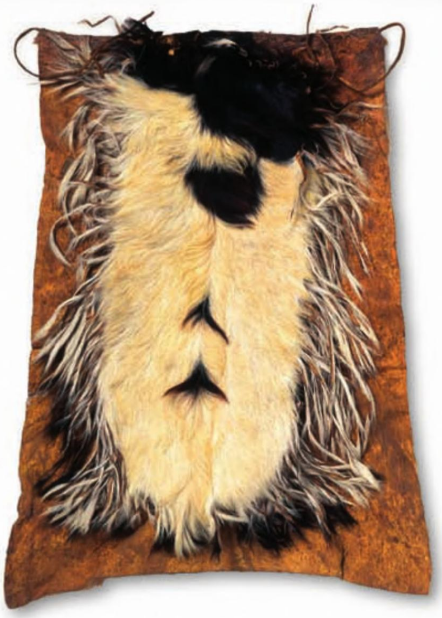
▲ ZULU HEADDRESS

Date 19th century

Origin South Africa

Material Monkey skin, feathers, fur

The warrior's headdress consisted of a decorative skin band that was set over a monkey-skin cap, with flaps for the neck and ears surmounted by further decoration, such as feathers or fur strips.



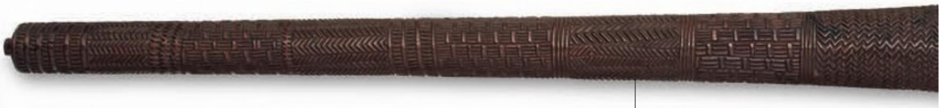
▲ ZULU UMUTSHA (APRON)

Date 19th century

Origin South Africa

Material Cowhide, goathair

The Zulu warrior's *umutsha* (apron or loincloth) covered his front and back. This example is decorated with goathair, and the pattern would have been unique to an *amabutho* (regiment).



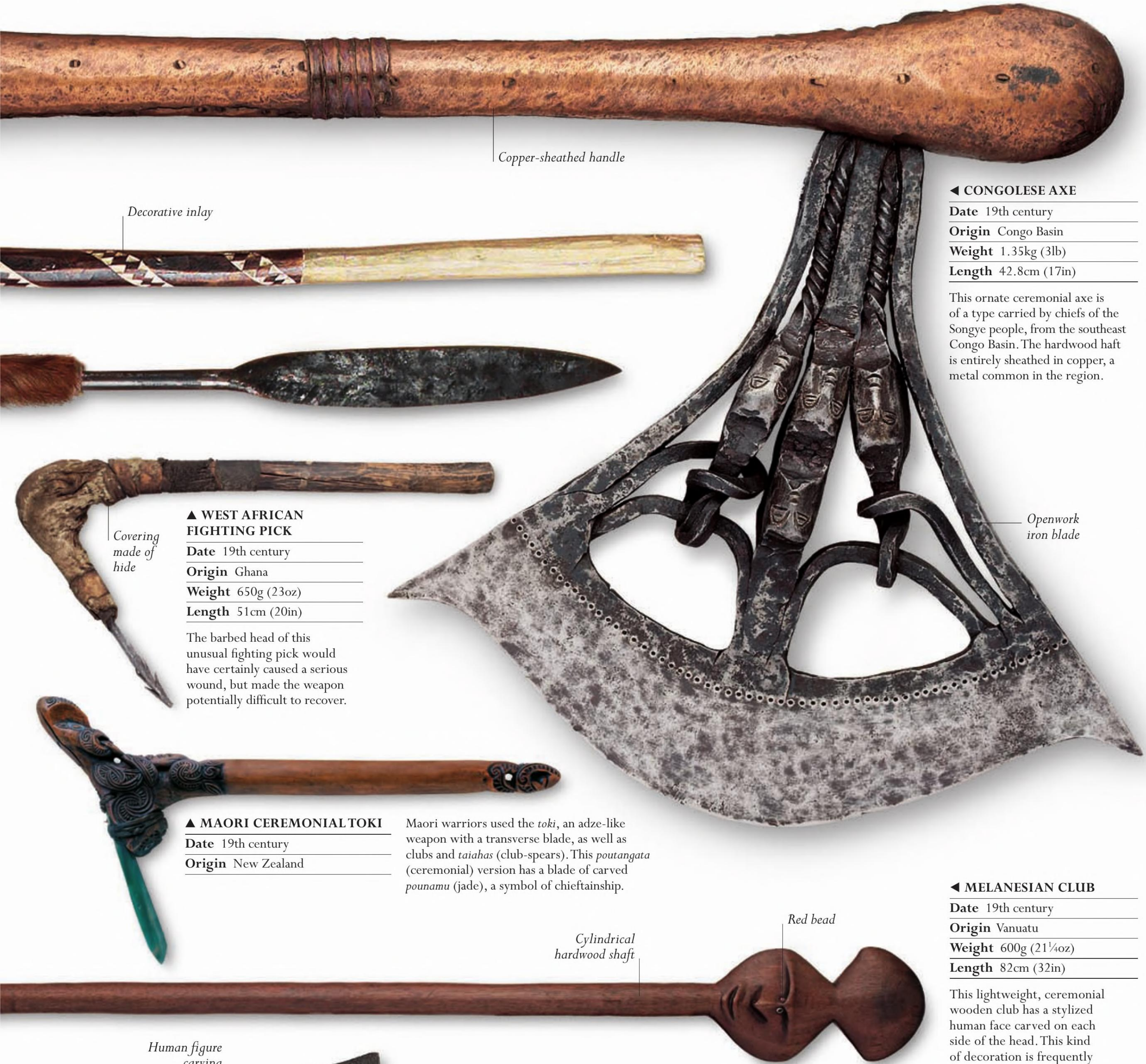
Carved geometric design

◀ ZULU SHIELD

Date 19th century

Origin South Africa

The Zulu warrior aimed to use the left side of his shield to hook the adversary's shield aside, exposing his body to a spear thrust. The pointed lower end of the shield-shaft was also employed as a weapon.



◀ CONGOLESE AXE

Date 19th century

Origin Congo Basin

Weight 1.35kg (3lb)

Length 42.8cm (17in)

This ornate ceremonial axe is of a type carried by chiefs of the Songye people, from the southeast Congo Basin. The hardwood haft is entirely sheathed in copper, a metal common in the region.

▲ WEST AFRICAN FIGHTING PICK

Date 19th century

Origin Ghana

Weight 650g (23oz)

Length 51cm (20in)

The barbed head of this unusual fighting pick would have certainly caused a serious wound, but made the weapon potentially difficult to recover.

▲ MAORI CEREMONIAL TOKI

Date 19th century

Origin New Zealand

Maori warriors used the *toki*, an adze-like weapon with a transverse blade, as well as clubs and *taiahas* (club-spears). This *poutangata* (ceremonial) version has a blade of carved *pounamu* (jade), a symbol of chieftainship.

◀ MELANESIAN CLUB

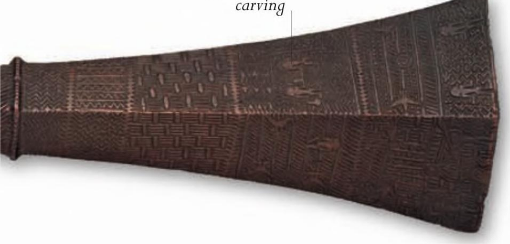
Date 19th century

Origin Vanuatu

Weight 600g (21¼oz)

Length 82cm (32in)

This lightweight, ceremonial wooden club has a stylized human face carved on each side of the head. This kind of decoration is frequently found across Oceania.



◀ TONGAN CLUB

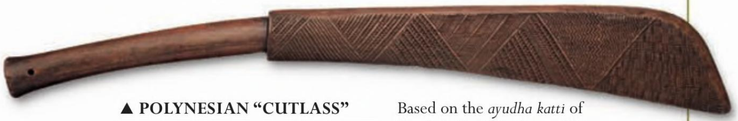
Date 19th century

Origin Tonga

Weight 1.3kg (3lb)

Length 82cm (32in)

This heavy, two-handed war club is carved along its length with geometric patterns, human figures, animals, and fish. The diamond-shaped head would have inflicted a crushing blow to the skull.



▲ POLYNESIAN "CUTLASS"

Date 19th century

Origin Polynesia

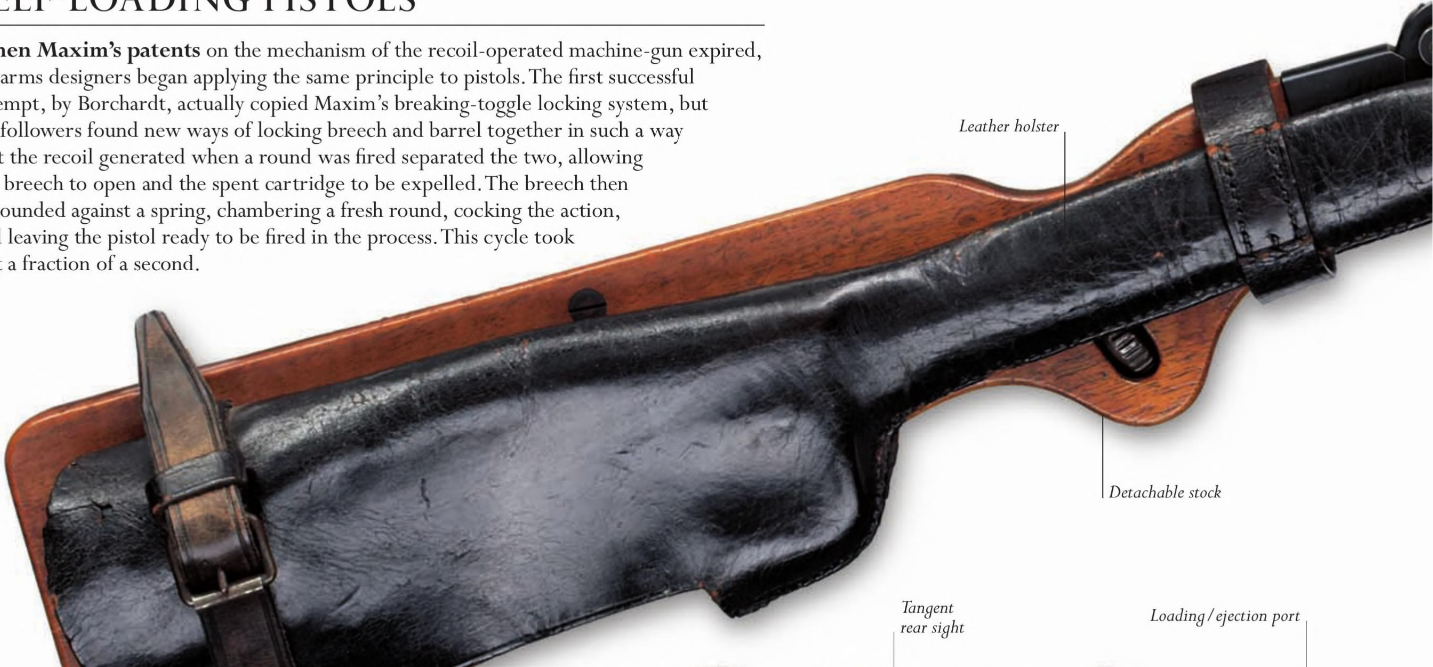
Weight 1.5kg (3¼lb)

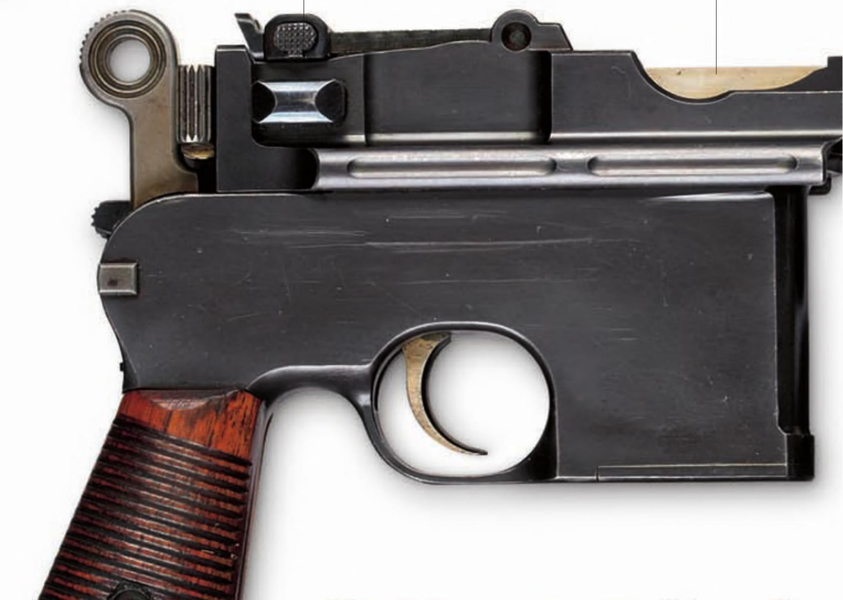
Length 77.5cm (30½in)

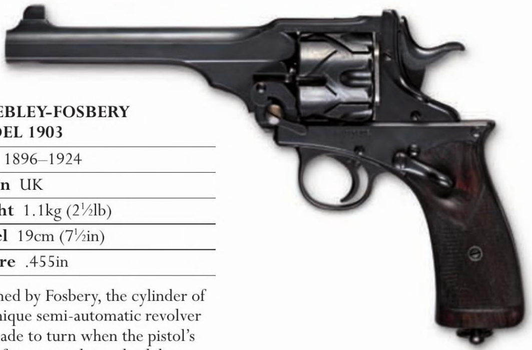
Based on the *ayudha katti* of South India, this cleaver-like club's triangular panels of geometric motifs are reminiscent of patterns found in ceremonial weavings.

SELF-LOADING PISTOLS

When Maxim's patents on the mechanism of the recoil-operated machine-gun expired, firearms designers began applying the same principle to pistols. The first successful attempt, by Borchardt, actually copied Maxim's breaking-toggle locking system, but his followers found new ways of locking breech and barrel together in such a way that the recoil generated when a round was fired separated the two, allowing the breech to open and the spent cartridge to be expelled. The breech then rebounded against a spring, chambering a fresh round, cocking the action, and leaving the pistol ready to be fired in the process. This cycle took just a fraction of a second.



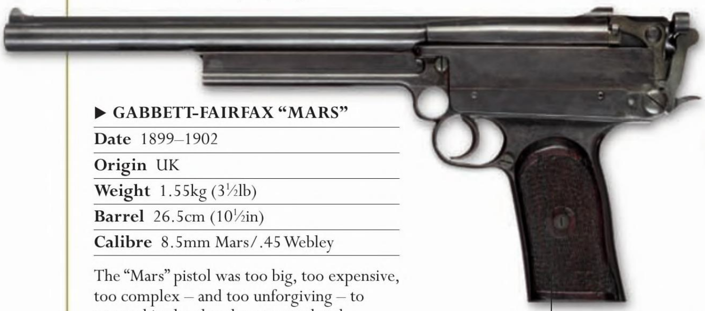




▶ WEBLEY-FOSBERY MODEL 1903

Date 1896–1924	
Origin UK	
Weight 1.1kg (2½lb)	
Barrel 19cm (7½in)	
Calibre .455in	

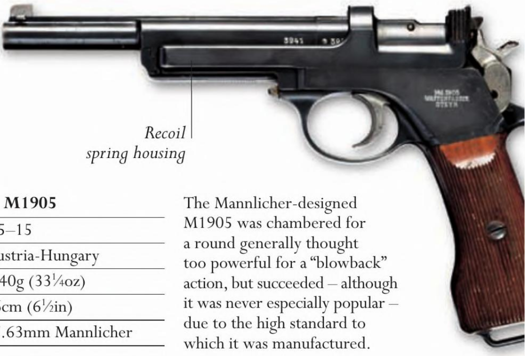
Designed by Fosbery, the cylinder of this unique semi-automatic revolver was made to turn when the pistol's upper frame was driven back by recoil and returned by a spring.



▶ GABBETT-FAIRFAX "MARS"

Date 1899–1902	
Origin UK	
Weight 1.55kg (3½lb)	
Barrel 26.5cm (10½in)	
Calibre 8.5mm Mars/.45 Webley	

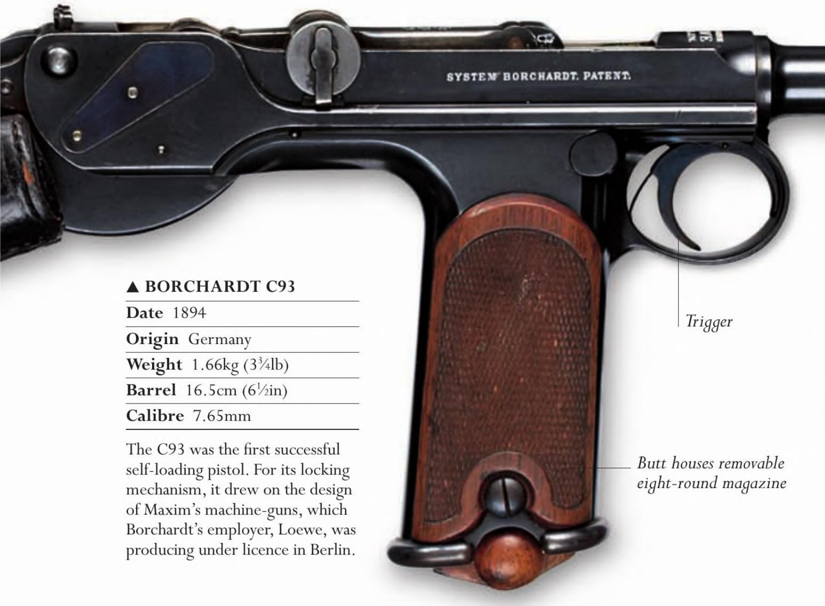
The "Mars" pistol was too big, too expensive, too complex – and too unforgiving – to succeed in the already congested and competitive weapon market of 1900.



▶ STEYR M1905

Date 1905–15	
Origin Austria-Hungary	
Weight 940g (33¼oz)	
Barrel 16cm (6½in)	
Calibre 7.63mm Mannlicher	

The Mannlicher-designed M1905 was chambered for a round generally thought too powerful for a "blowback" action, but succeeded – although it was never especially popular – due to the high standard to which it was manufactured.



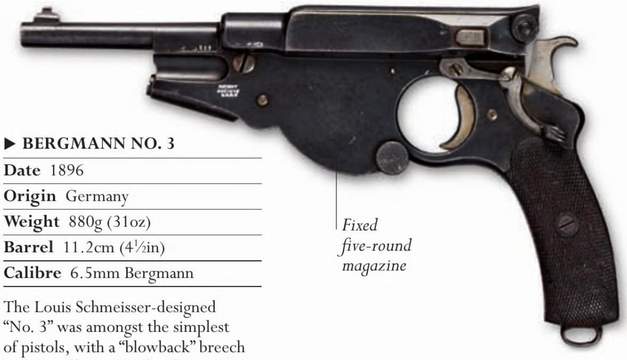
Trigger

Butt houses removable eight-round magazine

▲ BORCHARDT C93

Date	1894
Origin	Germany
Weight	1.66kg (3¾lb)
Barrel	16.5cm (6½in)
Calibre	7.65mm

The C93 was the first successful self-loading pistol. For its locking mechanism, it drew on the design of Maxim's machine-guns, which Borchardt's employer, Loewe, was producing under licence in Berlin.



Fixed five-round magazine

▶ BERGMANN NO. 3

Date	1896
Origin	Germany
Weight	880g (31oz)
Barrel	11.2cm (4½in)
Calibre	6.5mm Bergmann

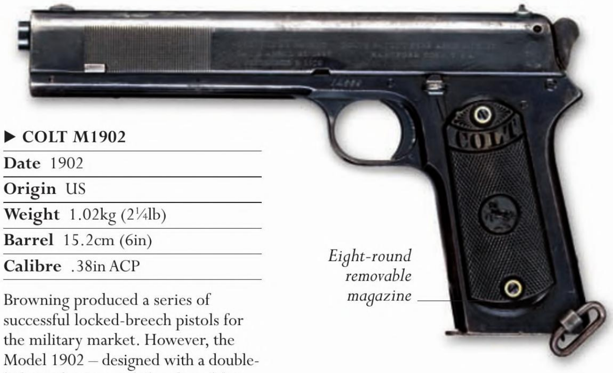
The Louis Schmeisser-designed "No. 3" was amongst the simplest of pistols, with a "blowback" breech and a small-capacity fixed magazine. The spent case was ejected by gas pressure alone.

Blade fore sight

▲ MAUSER C96

Date	1896–1930s
Origin	Germany
Weight	1.15kg (2½lb)
Barrel	14cm (5½in)
Calibre	7.63mm Mauser

Despite shortcomings, chief among which was its complexity, the Mauser C96, chambered for a particularly effective and popular round, was one of the most successful designs of its day.

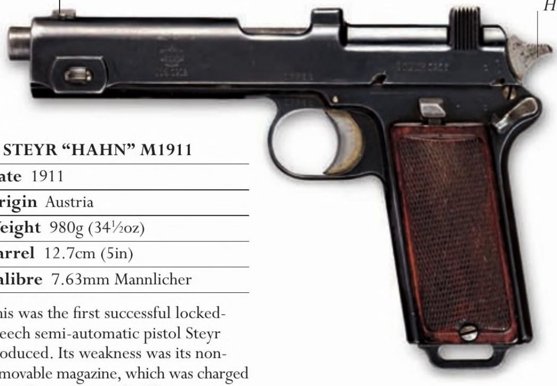


Eight-round removable magazine

▶ COLT M1902

Date	1902
Origin	US
Weight	1.02kg (2¼lb)
Barrel	15.2cm (6in)
Calibre	.38in ACP

Browning produced a series of successful locked-breech pistols for the military market. However, the Model 1902 – designed with a double-link mechanism and chambered for a lighter round – was not as popular.



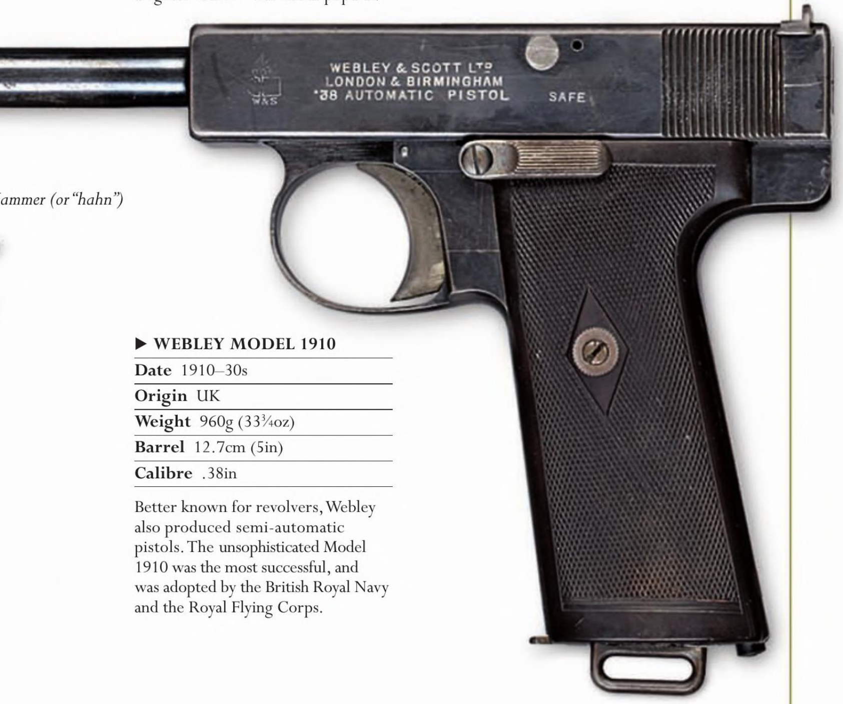
Barrel locking-lug

Hammer (or "hahn")

▶ STEYR "HAHN" M1911

Date	1911
Origin	Austria
Weight	980g (34½oz)
Barrel	12.7cm (5in)
Calibre	7.63mm Mannlicher

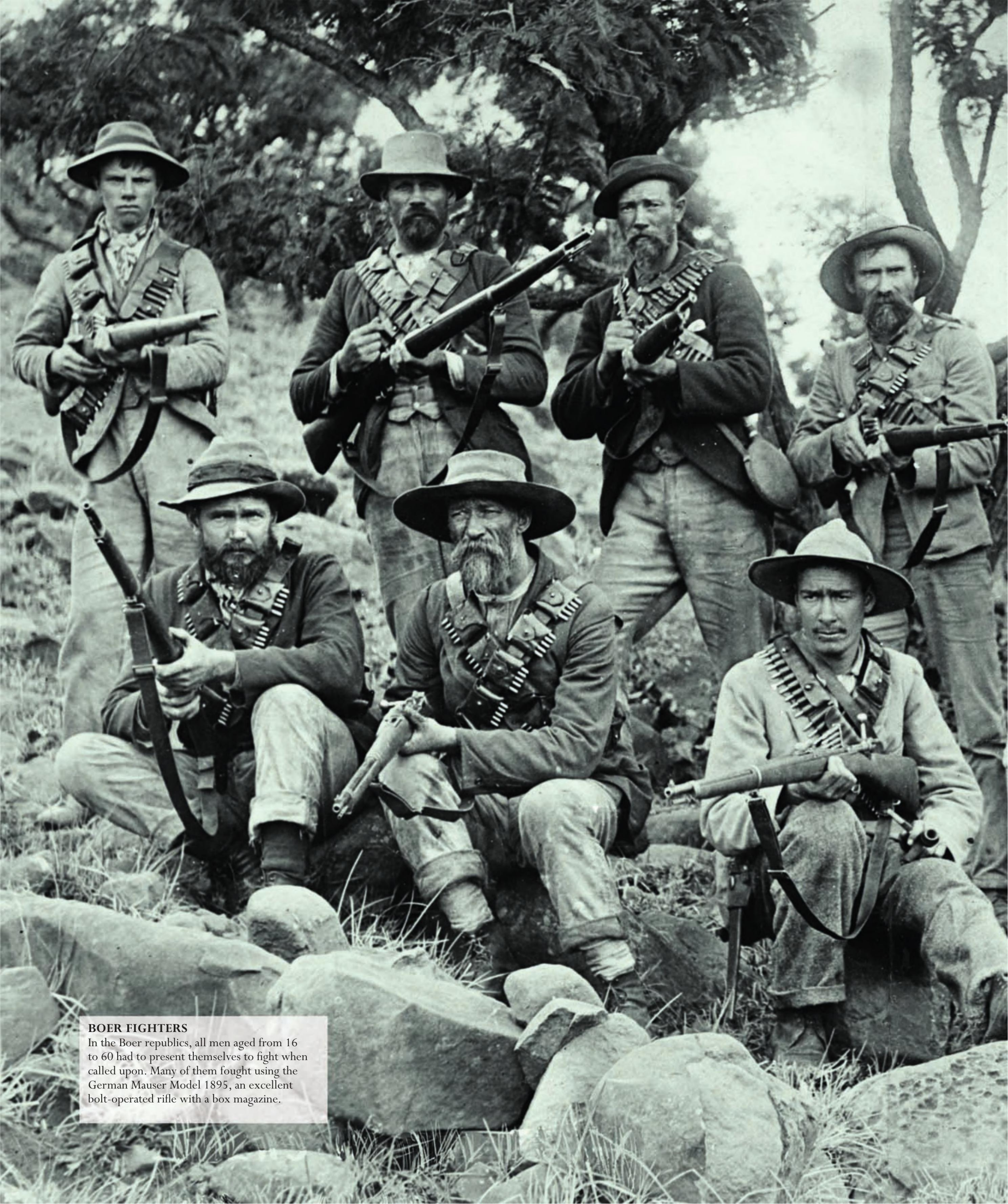
This was the first successful locked-breech semi-automatic pistol Steyr produced. Its weakness was its non-removable magazine, which was charged from above using a clip. This version was used by the Chilean armed forces.



▶ WEBLEY MODEL 1910

Date	1910–30s
Origin	UK
Weight	960g (33¾oz)
Barrel	12.7cm (5in)
Calibre	.38in

Better known for revolvers, Webley also produced semi-automatic pistols. The unsophisticated Model 1910 was the most successful, and was adopted by the British Royal Navy and the Royal Flying Corps.



BOER FIGHTERS
In the Boer republics, all men aged from 16 to 60 had to present themselves to fight when called upon. Many of them fought using the German Mauser Model 1895, an excellent bolt-operated rifle with a box magazine.

GUERRILLA WARFARE

SECOND BOER WAR

In October 1899 the independent Boer republics of the Transvaal and the Orange Free State launched a pre-emptive attack on British-ruled South Africa. The conflict later became a guerrilla war, in which lightly armed, mounted Boer commandos defied the military might of the British Empire.

The Boer forces were a citizen militia. Every adult male was issued with a rifle by the central government and was obliged to turn up for military service when called upon, bringing his weapon, ammunition, and a horse. The basic military unit was known as a "commando" – before the term took on its current meaning. The Boers' equipment was light but of high quality. They had the latest Mauser rifles and some state-of-the-art field artillery from the Krupp and Creusot factories in Europe. British infantry were equipped with Lee-Metford and Lee-Enfield rifles, and both sides made use of the machine-gun.

The advent of smokeless powder meant that rifles had become more accurate with better range, an advance which played to a Boer strength: they were excellent sharpshooters, skilled in exploiting cover, especially now that positions were no longer given away by gun smoke. They were also experienced in surviving on the South African veld. But the commandos had their weaknesses: officers were elected, which, though democratic, did not encourage strict discipline. Also most Boers were reluctant to fight far from their home areas, which limited offensive operations.

The Boer army had a series of initial successes, but then suffered repeated defeats as the British counterattacked in strength. In the summer of 1900 British troops occupied the Boer republics and declared the war won, but while some Boers accepted this outcome many did not. Battle-hardened Boer commanders such as Louis Botha, Koos de la Rey, and Christiaan de Wet decided to fight on. They launched a coordinated campaign of guerrilla warfare that caught the British occupying forces utterly unprepared. Able to move swiftly across the veld and resupply with the local Boer population, the mounted commandos struck at will against railway lines and telegraph wires, supply convoys, and isolated garrisons. Though hugely outnumbered by the British troops, the commandos' hit-and-run attacks denied Britain the chance to bring its superior forces into play. When Boer horsemen did enter into combat against British troops they were usually the victors, exploiting their speed of manoeuvre and superior knowledge of the terrain.

A SCORCHED EARTH POLICY

The British commander-in-chief, Lord Kitchener, responded with a ruthless counterinsurgency campaign. He built a chain of fortified blockhouses linked by barbed wire to protect the railways, before fencing in whole areas of the veld, which could then be swept to flush out the guerrillas. Large numbers of mounted troops were deployed in roaming columns to hunt the commandos. Most controversially, Boer farms, livestock, and crops were also destroyed to deny the guerrillas sustenance, and Boer women and children were herded into British "concentration camps", where thousands died of malnutrition and disease. Thus a pattern was established that was to recur throughout the 20th century – a major power drawn into deploying large-scale forces against an elusive enemy, and in the process politically discrediting its own cause.

In the end the commandos were not defeated, but their leaders recognized that the damage suffered by their own people was too great to be allowed to continue. The British were also eager to end the fighting and a compromise peace was agreed in May 1902.

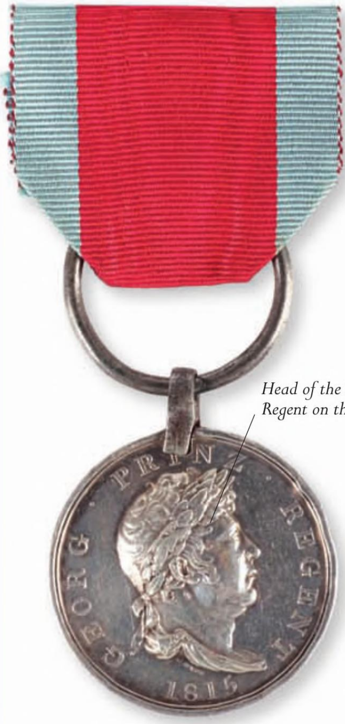
MILITARY MEDALS BEFORE 1914

The 19th century saw the birth of the military medal as we know it today. Previously such recognition of notable valour was reserved largely for those of high rank. During the Napoleonic Wars, however, medals began to be awarded to both officers and other personnel. The most prestigious medals were for exceptional acts of bravery, but others were given simply for participation in an action. The medals varied from coin-like medallions to more elaborate designs incorporating national symbols and mottos. In many cases clasps were used to specify the action or battle.

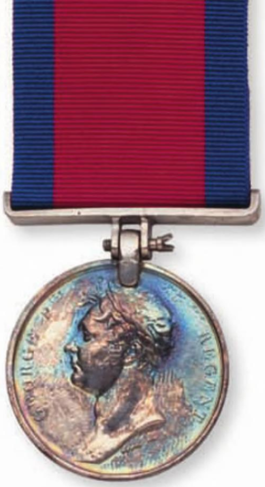
▼ HANOVERIAN MEDAL FOR WATERLOO

Date 1815
Origin Hanover
Conflict Napoleonic Wars

Authorized by George, the British Prince Regent, in his position as Elector of Hanover, this medal was given to Hanoverian troops who survived the Battle of Waterloo (1815).



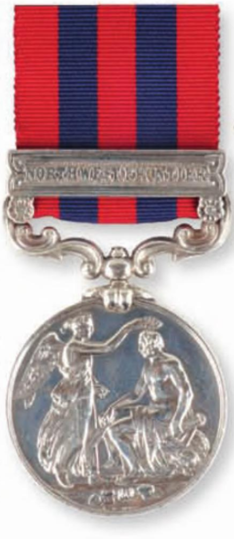
Head of the Prince Regent on the front



◀ WATERLOO MEDAL

Date 1815
Origin UK
Conflict Napoleonic Wars

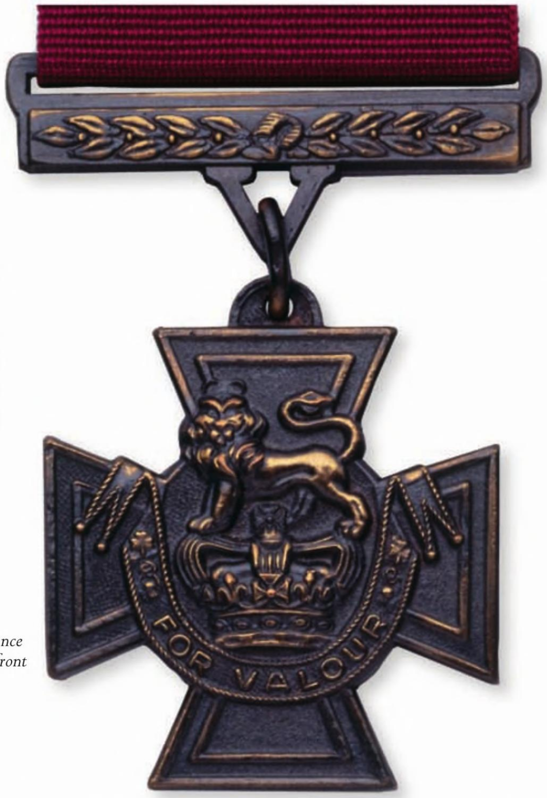
The first award to be issued to all ranks in a specific campaign, this was also the first to be awarded to the next-of-kin of fallen soldiers.



▶ INDIA GENERAL SERVICE MEDAL

Date 1854
Origin UK
Conflict Indian campaigns

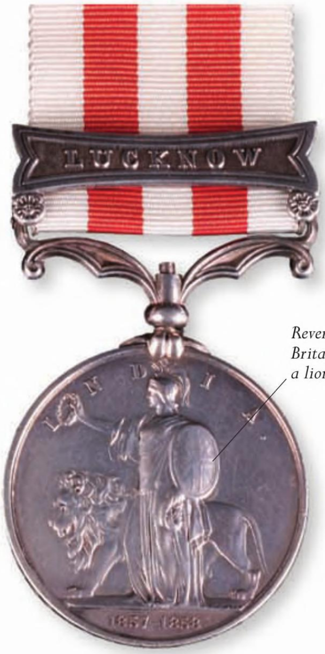
This medal was awarded to British and Indian servicemen from 1854 to 1895. Different ribbon clasps denoted specific battles or actions.



◀ VICTORIA CROSS

Date 1856
Origin UK

The Victoria Cross is the UK's premier award for gallantry. Originally struck from the gunmetal of captured Russian cannon, it was introduced to honour acts of exceptional valour in the Crimean War (1853–56).

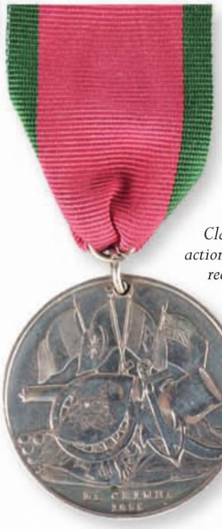


Reverse depicts Britannia with a lion

▲ INDIAN MUTINY MEDAL

Date 1858
Origin UK
Conflict Indian Rebellion

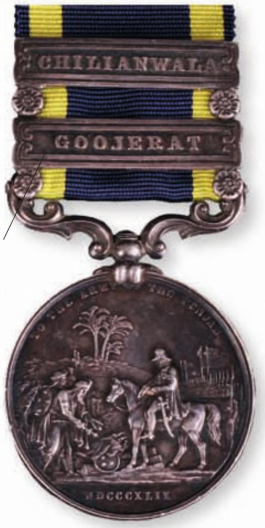
Initially given to British and Indian troops who had fought the Indian rebels, this award was later extended to civilians who had played a role in the suppression of the revolt.



▶ TURKISH CRIMEA MEDAL

Date 1855
Origin Turkey
Conflict Crimean War

The Turkish Crimea Medal, "Kinm Harbi Madalyasi", was awarded by Sultan Abdulmecid I of the Ottoman Empire to all allied military personnel, including British, French, and Sardinian troops, who fought in the Crimean War (1853–56).



Clasp denotes actions in which recipient was involved

◀ PUNJAB MEDAL

Date 1849
Origin UK
Conflict Punjab campaign

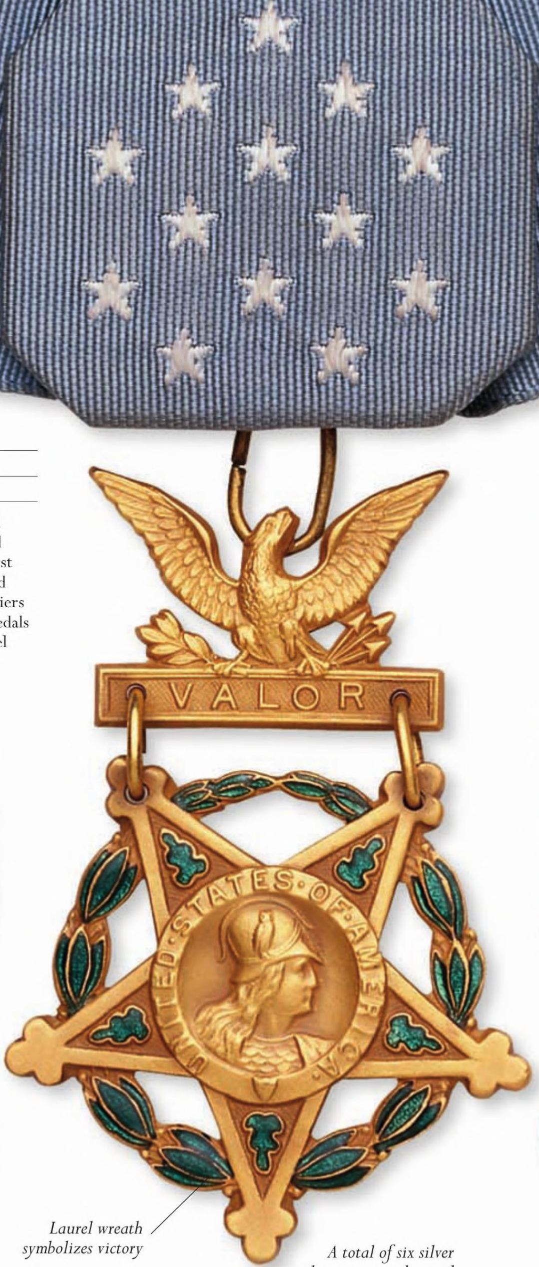
This award was made to officers and men of the British Army and East India Company who served in the Punjab campaign of 1848–49.

▲ MEDAL OF HONOR

Date 1861

Origin US

The Medal of Honor is the highest medal for "valor in combat" that can be awarded to members of the US Armed Forces. First authorized in 1861 for issue to sailors and marines, the medal was extended to soldiers in 1862. Since then, more than 3,400 Medals of Honor have been awarded to personnel from all the armed services.


VALOR
UNITED STATES OF AMERICA

Laurel wreath symbolizes victory

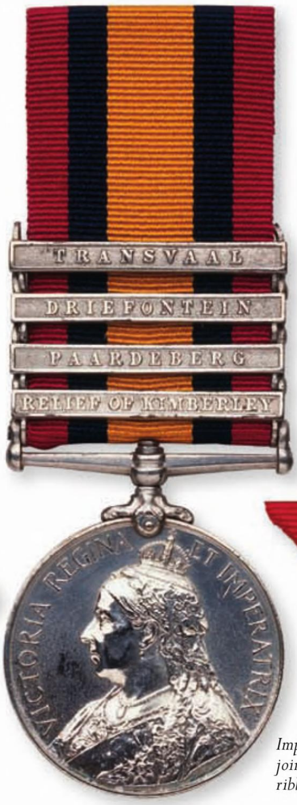
◀ QUEEN'S SOUTH AFRICA MEDAL

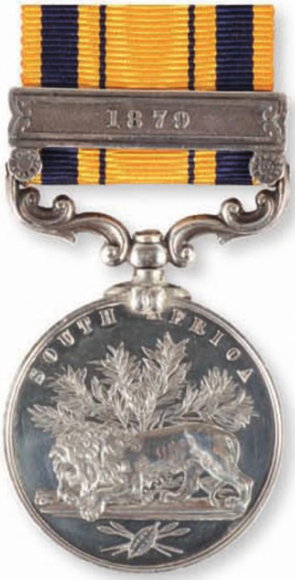
Date 1899

Origin UK

Conflict Anglo-Boer Wars

Awarded to personnel who served in the Second Anglo-Boer War in South Africa (1899–1902), with 178,000 medals issued, and 26 authorized clasps, this is one of the most widespread of all military medals.


TRANSVAAL
DRIEFONTEIN
PAARDEBERG
RELIEF OF KIMBERLEY
VICTORIA REGINA ET IMPERATRIX


1879
SOUTH AFRICA

▲ SOUTH AFRICA MEDAL

Date 1879

Origin UK

Conflict South Africa campaigns

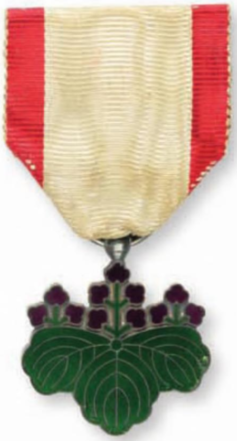
This was issued by the British Government to members of the British Army and Naval Brigade who served in the South African tribal wars between 1877 and 1879. Most awards were made for actions during the Anglo-Zulu War (1879), especially the battles of Isandlwana and Rorke's Drift.

▶ ORDER OF THE RISING SUN

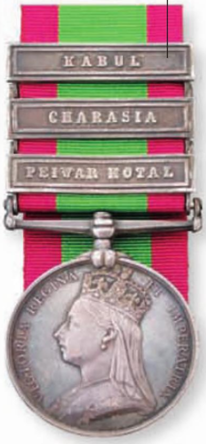
Date 1875

Origin Japan

Established in 1875 by Emperor Meiji of Japan, the Order of the Rising Sun was the country's first national decoration. The version shown here is a 7th class medal, showing Paulownia flowers and leaves.



A total of six silver clasps were authorized


KABUL
CHARASIA
PEIWAR KOTAL
VICTORIA REGINA ET IMPERATRIX

◀ AFGHANISTAN MEDAL

Date 1881

Origin UK

Conflict Anglo-Afghan Wars

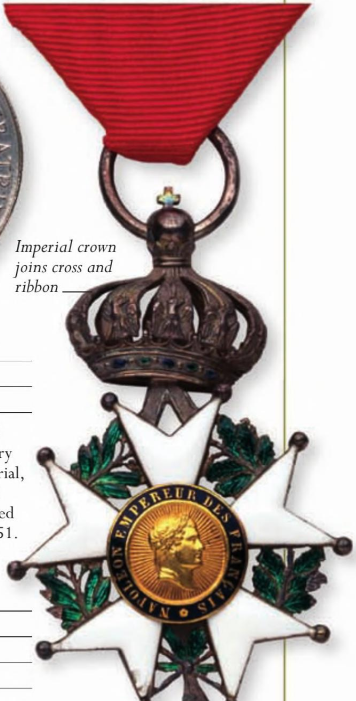
This medal was awarded to British and Indian forces, who took part in the Second Anglo-Afghan War, which consisted of a series of battles between 1878 and 1880. The war ended with a British victory at Kandahar in 1880.

▶ LÉGION D'HONNEUR

Date 1802

Origin France

Instituted by Napoleon Bonaparte in 1802 as an award for outstanding civil or military service to France, the Ordre Royal, Impérial, et National de la Légion d'Honneur is still one of France's highest awards. The pictured design was awarded between 1870 and 1951.


NAPOLEON EMPEREUR DES FRANÇAIS

Imperial crown joins cross and ribbon

KEY DEVELOPMENT

STEAM, IRONCLADS, AND THE FIRST BATTLESHIPS

In the century between the Napoleonic Wars and the outbreak of World War I, new technology transformed naval warfare. Sail gave way to steam, wooden hulls were superseded by metal ones, and high-explosive shells replaced cannonballs.

The sailing ship navies of Nelson's era (see p.196) did not disappear overnight; at first, steamships were only viable in coastal and inland waters. Their large paddle wheels limited the space available for gunports and were vulnerable to enemy fire, but steam ships had the clear advantage of being able to manoeuvre at will, even in a dead calm. The introduction, in the 1840s, of screw propellers as an alternative to paddle wheels led to the adoption of steam engines as a standard feature of warships, although initially as an auxiliary to the sails.

RISE OF THE IRONCLAD

The 1840s also saw the Paixhans gun revolutionize naval armament: it was the first naval gun designed to fire explosive shells instead of solid shot. In response, during the 1850s, some wooden-hulled ships were armoured with thick iron plate above the waterline. These ironclad ships were deemed a success during the Crimean War (1853–56), fought between Russia and the allied forces of Britain, France, the Ottoman Empire, and Kingdom of Sardinia. In 1859, France built the first ironclad battleship, *La Gloire*, which was matched by the British HMS *Warrior* the following year.

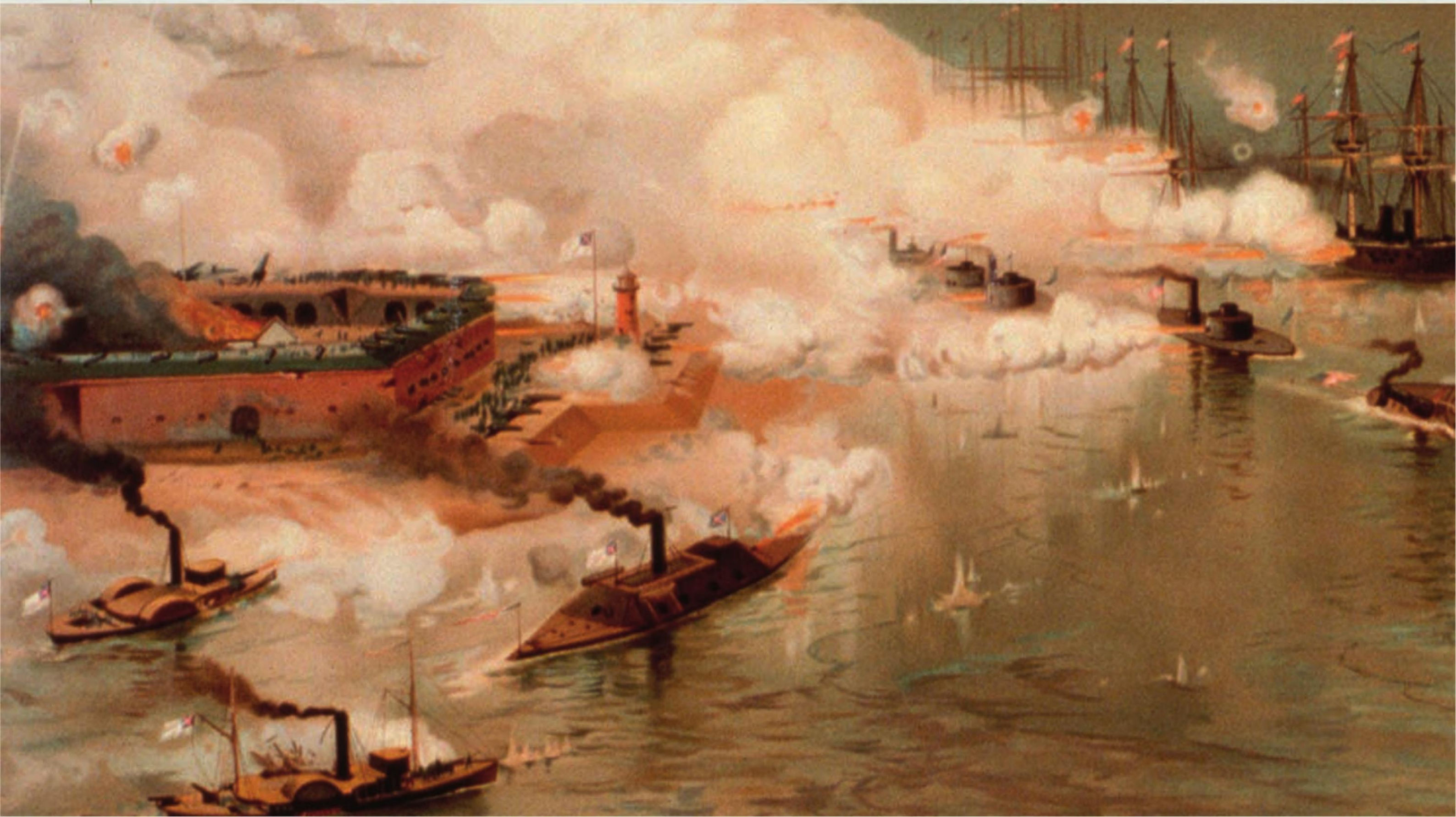
The American Civil War began in 1861. The Confederates rebuilt an existing ship as the ironclad CSS *Virginia*, while their opponents sponsored a radical new design, the USS *Monitor* – a metal raft equipped with two Dahlgren guns in a rotating turret. At the Battle of Hampton Roads, in March 1862, CSS *Virginia* sank two conventional Union frigates with frightening ease, but then fought a stalemated duel with USS *Monitor* in what was to be the first battle between two ironclad steamships.

Experiments with ironclad ships continued throughout the Civil War: the Union forces built more monitors (named after the original), as well

KEY **EVENTS**

1800–1950

- **1841** An iron-hulled steam-powered gunboat, *Nemesis*, plays a key role in the British defeat of China in the First Opium War.
- **1853** Making the first use of explosive shells in a naval battle, a Russian squadron destroys 11 Turkish ships at the Battle of Sinope, during the Crimean War.
- **1897** The US Navy adopts the first successful powered submarine, designed by Irish-American John Holland.
- **1904** Japanese destroyers armed with Whitehead torpedoes make a surprise attack on the Russian fleet at Port Arthur.
- **1911** Britain's Royal Navy decides that its new *Queen Elizabeth*-class battleships will use oil as fuel, instead of coal.



▼ METAL AGAINST METAL
In 1864, during the American Civil War, Union admiral David Farragut penetrated Confederate-held Mobile Bay with a squadron of metal monitors and wooden ships. One monitor was sunk by a mine, but Farragut disabled the Confederate ironclad CSS *Tennessee*.

> “The **storm of shot and shell** launched against the Spaniard was **destructive beyond all description**”
>
> **LIEUTENANT J L STICKNEY**, EYEWITNESS TO THE BATTLE OF MANILA, 1898

as a fleet of iron-armoured paddle steamers, to fight on the Mississippi. By the conclusion of the Civil War, in 1865, the superiority of ironclad steamships over wooden sailing ships was generally accepted. In 1871, the British built HMS *Devastation*, the first capital warship to have no sails at all. However, a new configuration of naval warfare still took time to emerge: the design of naval guns and their positioning on ships went through a stuttering development. For a time, naval designers became obsessed with rams, imagining that armour would make warships immune to gunfire; they pictured a return to the tactics of Ancient Greece in which steamships manoeuvred like triremes in a bid to sink enemy vessels with their reinforced prows.

Eventually a system was devised for mounting large rifled guns in rotating armoured turrets, with the magazine and ammunition stored in the hull below. These guns fired high-explosive shells at long range, requiring the invention of complex range-finding devices. Hulls were now made from metal and clad in steel armour, but the increasing power of explosives meant that ships remained vulnerable to this kind of gunfire. In addition, the adoption of steam power was not without its drawbacks. Sailing ships had not needed fuel, but coaling stations were now essential to naval operations, giving a new twist to geopolitics. When coal began to be replaced by oil, the possession of oilfields became a primary strategic concern for naval powers.

NAVAL RACE

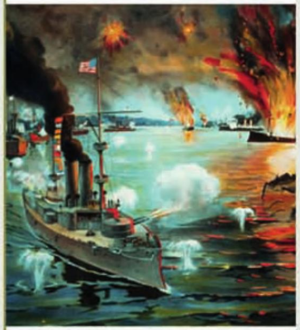
By the end of the 19th century, navies had become supreme status symbols for competing imperial powers. The US, Japan, and Germany embarked on large-scale naval construction programmes, to which the UK actively responded, determined to maintain its long-established naval supremacy. In the first decade of the 20th century, a frenzied naval race between the British and the Germans saw the UK repeatedly raise the bar with faster, more powerfully armed battleships, starting with the epoch-making HMS *Dreadnought* in 1906. Yet while naval commanders and a jingoistic public were obsessed with large warships – battleships, battlecruisers, and cruisers – other developments in naval warfare made these expensive vessels worryingly vulnerable. Sea mines, first used in the Crimean War, could sink any capital ship – and so could boats armed with torpedoes, whose worth was ably demonstrated by the Japanese during their war with Russia from 1904 to 1905. Destroyers were devised to defend the fleet against attack by torpedo boats, as well as launching torpedoes themselves, but navies had no technology for defence against torpedo-armed submarines, which became a practical element of navies in the first decade of the 20th century.

KEY **BATTLE**

THE BATTLE OF MANILA

1 MAY 1898

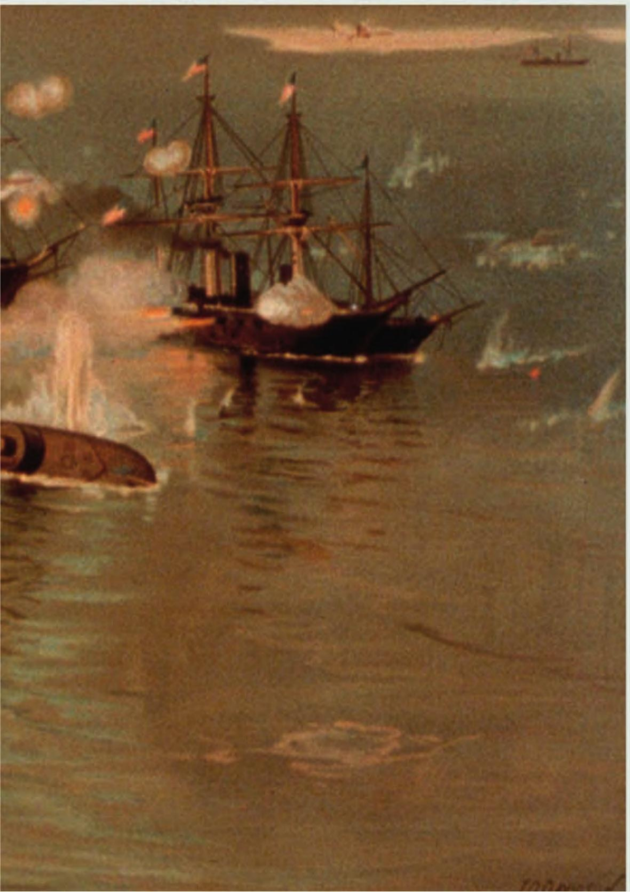
The Spanish–American War of 1898 was the first test of the American “New Navy” of modern battleships and cruisers. The Asiatic Squadron under Commodore George Dewey sank seven Spanish warships in the Philippines without loss.



▲ American battleships steaming in line destroy Spanish warships in Manila Bay.

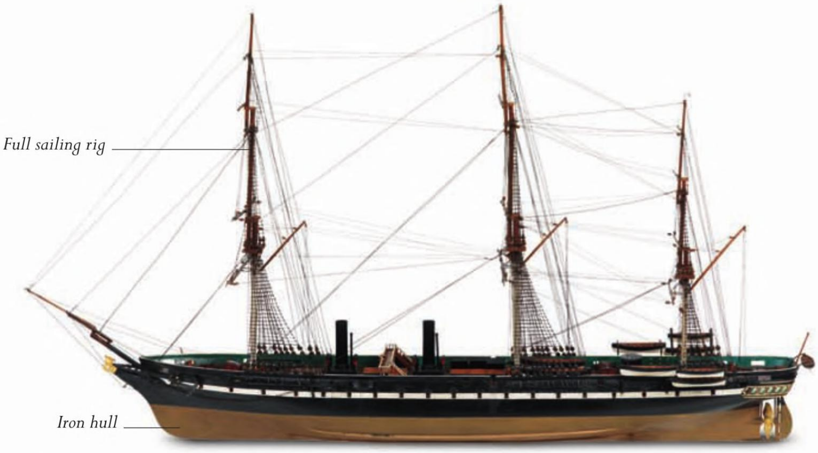
▼ WHITEHEAD TORPEDO
In the 1860s, British engineer Robert Whitehead invented the first effective self-propelled torpedo. Carried by small ships, the torpedo threatened to undermine the dominance of heavily gunned warships.

▼ DAHLGREN GUN
Invented by US naval officer John A Dahlgren, the Dahlgren gun was in frequent use during the American Civil War. Its distinctive soda-bottle shape gave more power than a conventional naval gun.



BATTLESHIPS

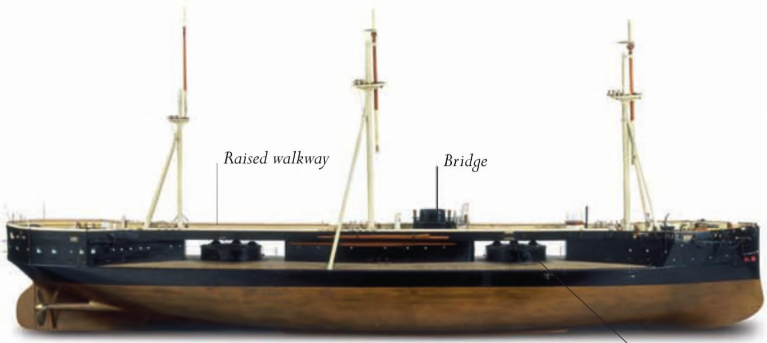
The second half of the 19th century was a time of considerable technological innovation at sea. Already the world's naval forces had begun to embrace steam propulsion, but now the very essence of the warship was to undergo a complete transformation, as wood and wind gave way to steel and steam. New types of weapons, as well as new ways of handling them, were developed and introduced. A dramatic transition occurred in a period of just 40 years, and in a world known for its innate conservatism and reluctance to accept change, this was no mean achievement.


Full sailing rig
Iron hull

▲ HMS WARRIOR

Commissioned 1861 **Origin** UK
Displacement 9,140 tons
Length 128m (420ft)
Top speed 14.1 knots

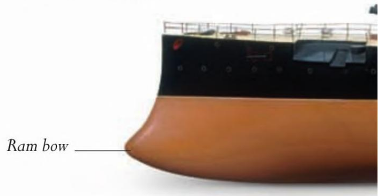
The *Warrior* and its sister-ship HMS *Black Prince* were the first ocean-going "ironclads", with 11.5cm (4½in) of armour on 45.7cm (18in) wooden hulls, screw propellers as well as a full sailing rig, and breech-loading guns.

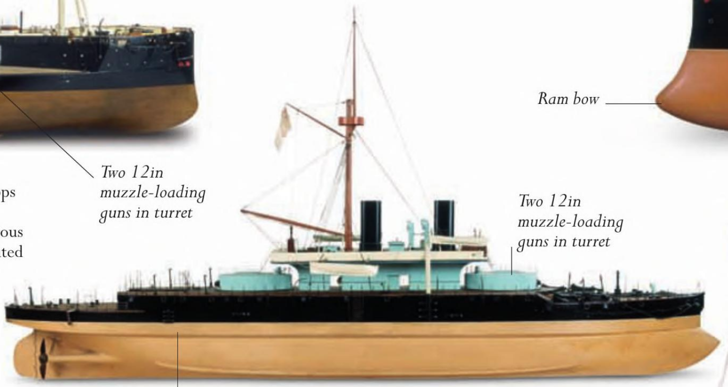

Raised walkway
Bridge
Two 12in muzzle-loading guns in turret

▲ HMS CAPTAIN

Commissioned 1870 **Origin** UK
Displacement 7,770 tons
Length 97.5m (320ft)
Top speed 15.25 knots

An experimental ship produced to the design of Captain Cowper Phipps Coles, a pioneer of the gun turret, HMS *Captain* proved to be a disastrous mistake. Its low freeboard contributed to its loss during a severe storm in September 1870.

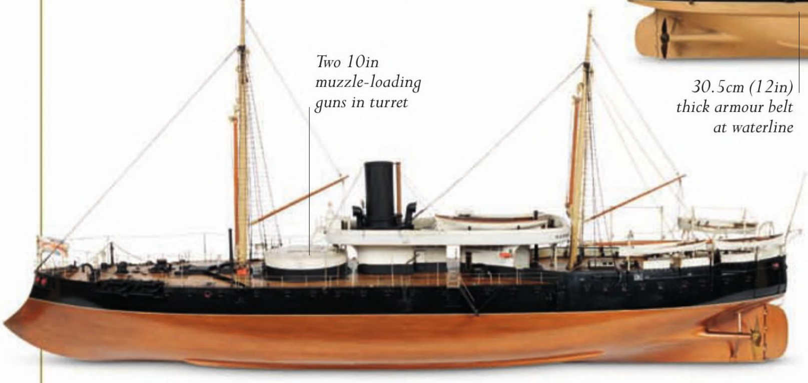



Two 12in muzzle-loading guns in turret
30.5cm (12in) thick armour belt at waterline

▲ HMS DEVASTATION

Commissioned 1873 **Origin** UK
Displacement 9,330 tons
Length 93.6m (307ft)
Top speed 13.5 knots

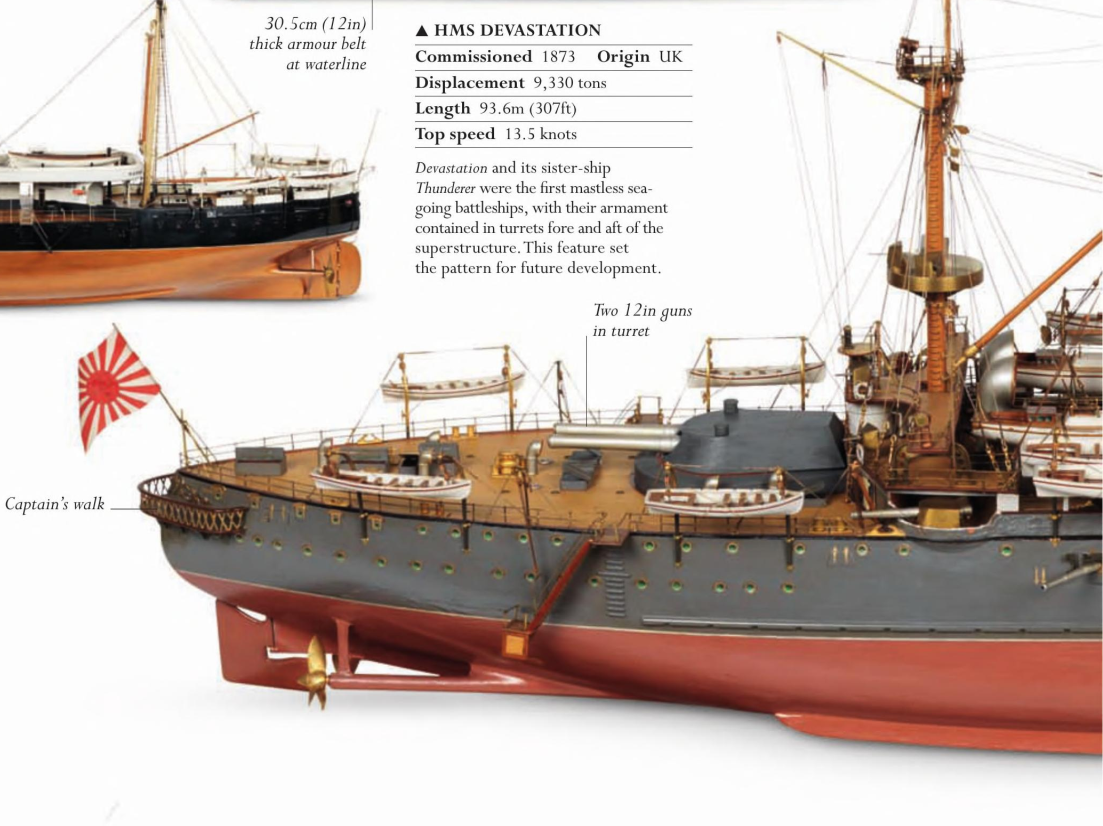
Devastation and its sister-ship *Thunderer* were the first mastless sea-going battleships, with their armament contained in turrets fore and aft of the superstructure. This feature set the pattern for future development.


Two 10in muzzle-loading guns in turret

▲ HMS RUPERT

Commissioned 1874 **Origin** UK
Displacement 5,440 tons
Length 80.5m (264ft)
Top speed 14 knots

Following the success of ramming tactics at the Battle of Lissa in 1866, many navies built ships specifically designed to sink others by ramming them. The British Royal Navy commissioned four, including *Rupert*, but none ever saw combat.


Two 12in guns in turret
Captain's walk

▶ **HMS INFLEXIBLE**

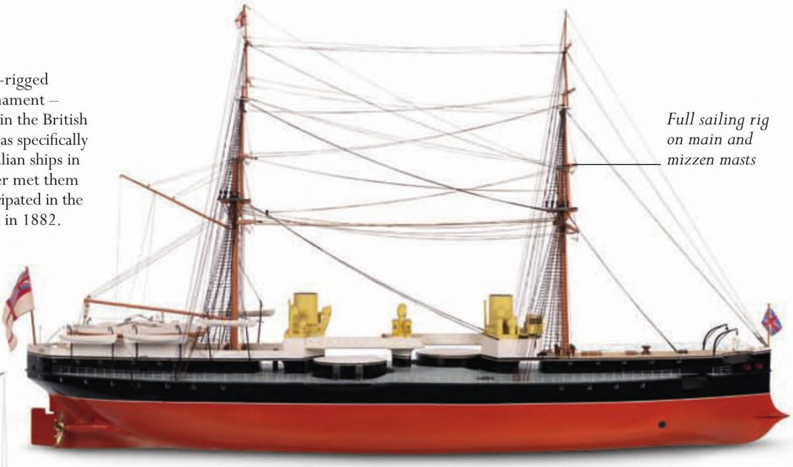
Commissioned 1881 **Origin** UK

Displacement 11,880 tons

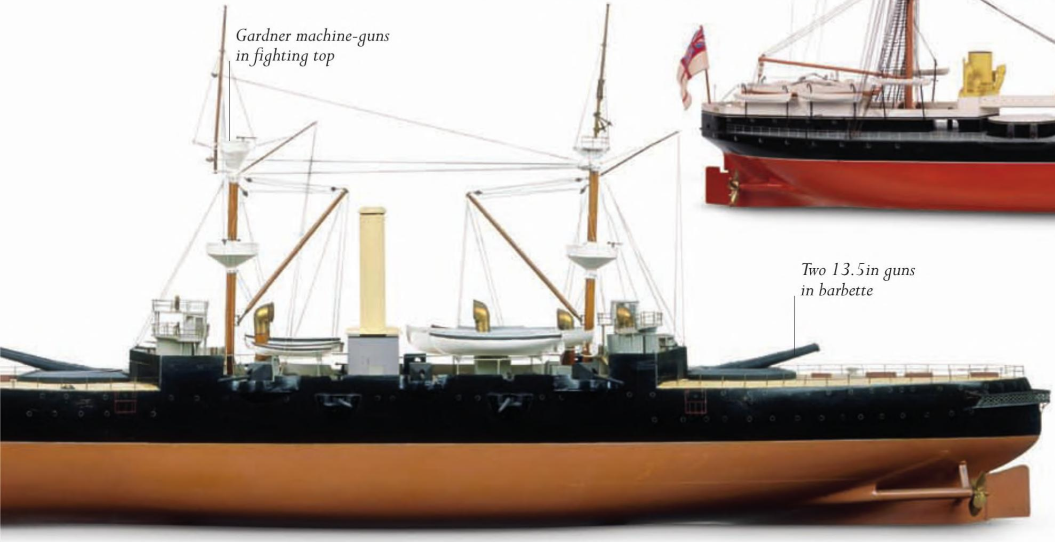
Length 104.9m (344ft)

Top speed 15 knots

Inflexible was a hybrid: a full-rigged "ironclad" with its main armament – the heaviest muzzle-loaders in the British Royal Navy – in turrets. It was specifically designed to match similar Italian ships in the Mediterranean, but never met them in conflict, although it participated in the bombardment of Alexandria in 1882.



Full sailing rig on main and mizzen masts



Gardner machine-guns in fighting top

Two 13.5in guns in barbette

◀ **HMS ROYAL SOVEREIGN**

Commissioned 1892 **Origin** UK

Displacement 15,580 tons

Length 124.9m (410ft)

Top speed 15 knots

The leader of a class of seven ships, the *Royal Sovereign* was the first of what became known as the pre-dreadnought battleships, mounting just four large-calibre guns and a sizeable battery of smaller, quick-firing weapons designed to fight off cruisers and destroyers.

▶ **HMS HINDUSTAN**

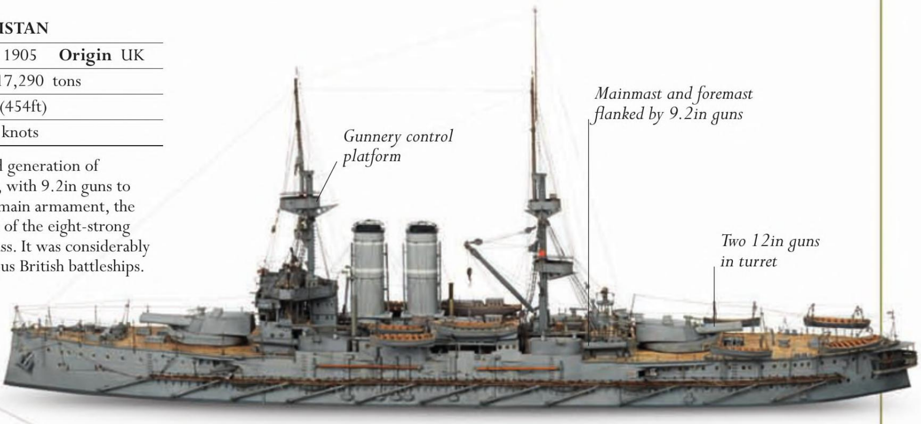
Commissioned 1905 **Origin** UK

Displacement 17,290 tons

Length 138.3m (454ft)

Top speed 18.5 knots

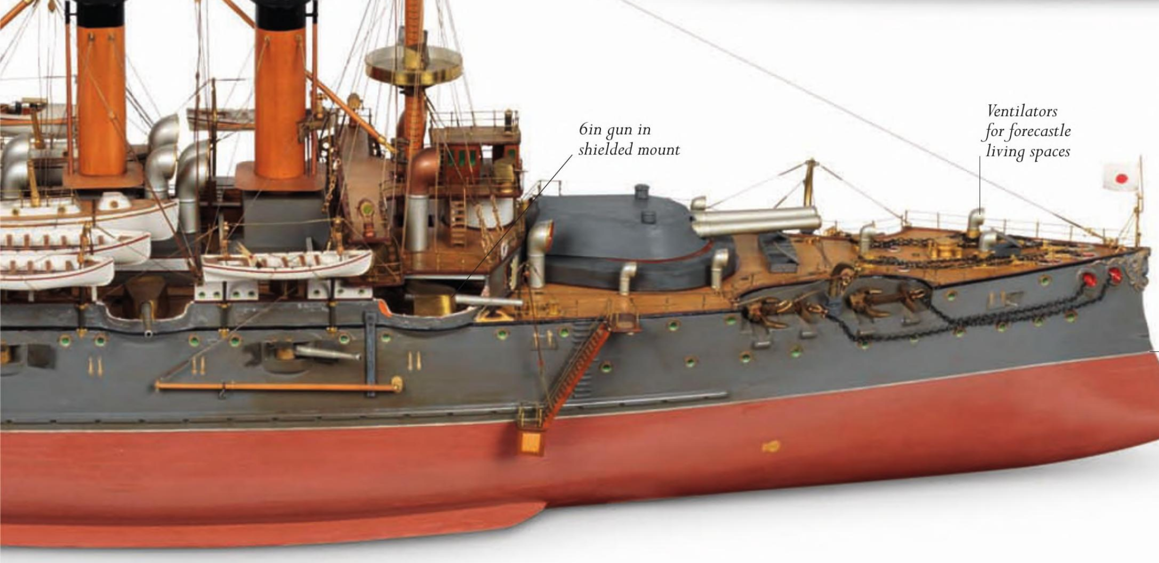
One of the second generation of pre-dreadnoughts, with 9.2in guns to supplement their main armament, the *Hindustan* was one of the eight-strong *King Edward VII* class. It was considerably bigger than previous British battleships.



Gunnery control platform

Mainmast and foremast flanked by 9.2in guns

Two 12in guns in turret



6in gun in shielded mount

Ventilators for forecastle living spaces

18in thick armour belt at waterline

◀ **FUJI**

Commissioned 1897 **Origin** Japan

Displacement 12,535 tons

Length 125.5m (412ft)

Top speed 18 knots

Built on the Thames in London, England, the *Fuji* and its sister-ship *Yashima* were the Imperial Japanese Navy's first modern battleships. The *Fuji* sunk the Russian *Borodino* at the Battle of Tsushima, Japan, on 25 May 1905.

THE BATTLE OF TSUSHIMA

In the second half of the 19th century, new technology transformed the world's navies. Wooden sailing ships were replaced by steel warships with coal-fired engines, armed with powerful rifled guns in rotating turrets. The Russians and Japanese fought the first fleet encounter between these formidable vessels in the Tsushima Strait in May 1905.

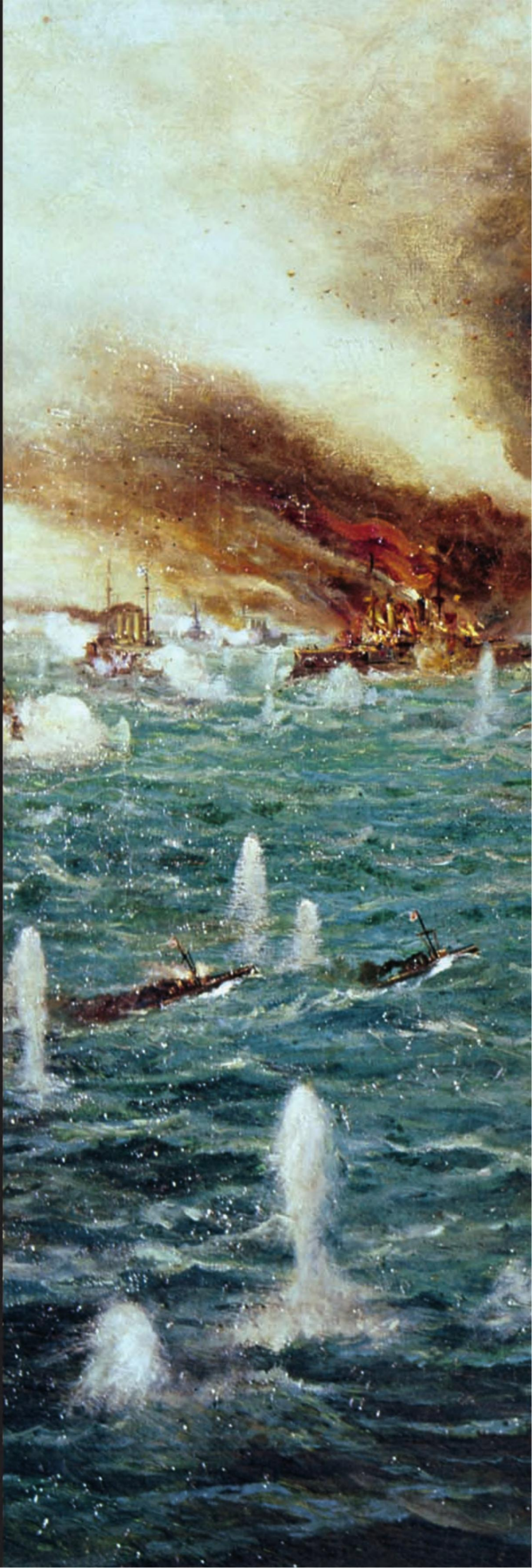
Russia and Japan went to war in 1904 over their rival ambitions to control Manchuria and Korea. From the outset the Japanese Imperial Navy outclassed the Russian Pacific Fleet based at Port Arthur and Vladivostok. In a bold bid to redress the balance, Russia decided to send a large part of its Baltic Fleet from European waters to East Asia, a gruelling voyage that took seven months. By the time the Russian ships reached the Pacific, Port Arthur had fallen to the Japanese. The Russians had to head for Vladivostok, further north, which meant steaming past Japan. Short of coal, Russian Admiral Zinovy Petrovich Rozhestvensky chose the shortest route, through the Tsushima Strait between Japan and Korea.

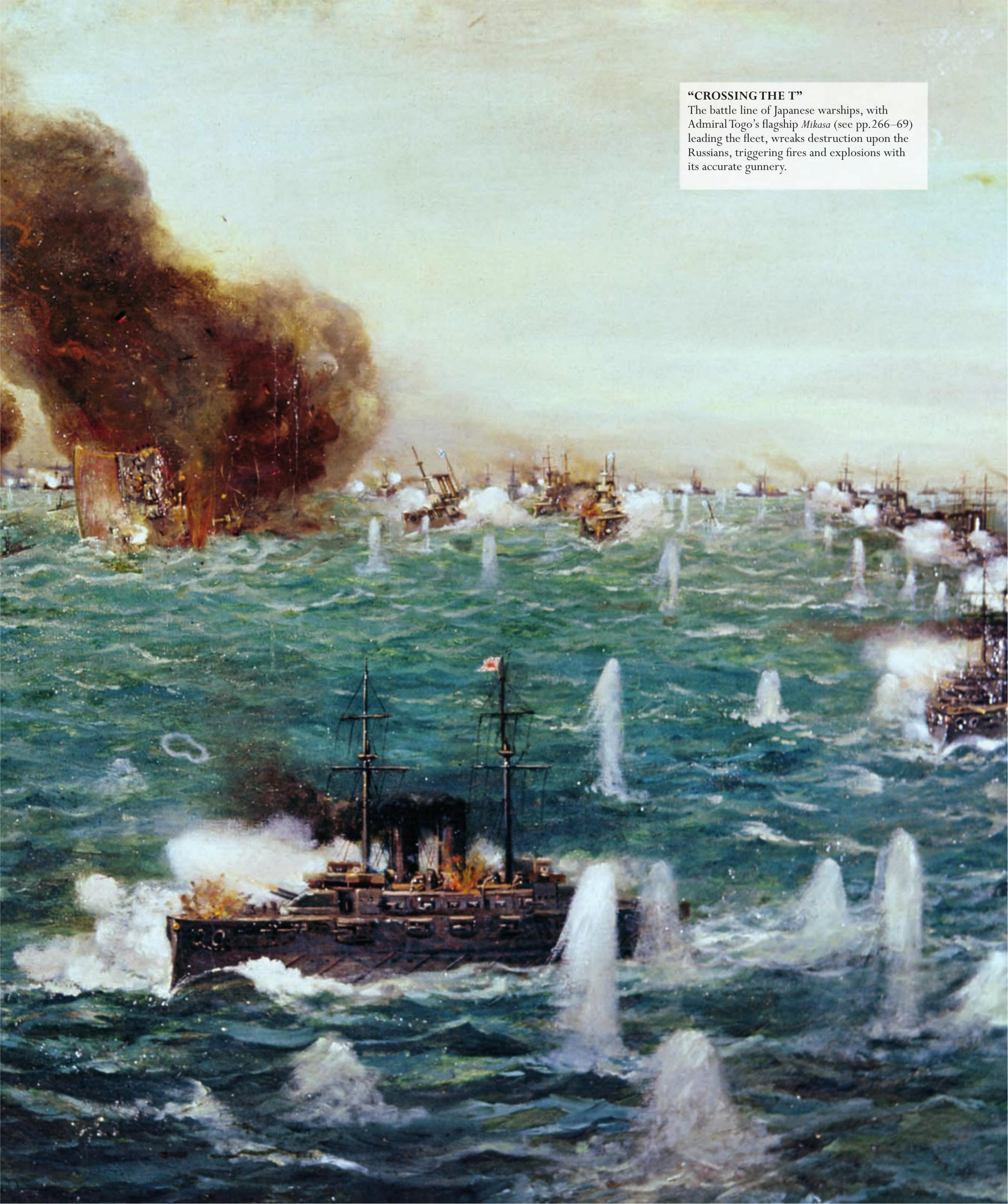
Japanese commander Admiral Togo Heihachiro was on the lookout for the Russian fleet, the progress of which around the world had been a public event. Rozhestvensky hoped to dash through the Strait under cover of darkness, and he might have succeeded but for a new invention: wireless telegraphy (radio). When a Japanese vessel patrolling the Strait spotted the Russian fleet, it was able to inform Admiral Togo instantly. Fast-moving Japanese cruisers kept in visual contact with the Russians, radioing their position to Togo so he could direct his main force in pursuit. The Japanese fleet had no difficulty intercepting the Russians, as it enjoyed a substantial speed advantage, steaming at around 15 knots against the 6 knots of the Russian vessels. Battle was joined on the afternoon of 27 May.

Both fleets steamed in "line astern" formation – one vessel following another – allowing their turret guns a maximum field of fire without the risk of hitting a friendly ship. Togo turned his fleet to sail parallel to the Russians, with his flagship *Mikasa* in the vanguard. The exchange of fire began at a range of around 5,500 metres (6,000 yards). Crucially, the Japanese had superior range-finding technology, vital if gunners were to hit a target at such distance. They also had shells more suitable for the conditions: whereas the Russians fired armour-piercing rounds, the Japanese shells were fused to explode on contact. Packed with high explosives, they devastated the superstructure of ships they hit, starting fires and raking the decks with deadly steel splinters. Moreover, the Japanese fleet's speed advantage enabled them to "cross the T", sailing their ships across the front of the Russian line. This manoeuvre brought all their guns to bear on the Russians, while the Russians could only reply with some of their forward guns.

ENDGAME

By nightfall the outclassed Russian fleet had suffered devastation; Admiral Rozhestvensky, a piece of steel embedded in his skull, was among thousands of casualties. When one of the Russian battleships, the *Borodino*, exploded, a shell striking one of its magazines, 784 of its 785 crew were killed. After dark, the Japanese unleashed their destroyers and torpedo boats upon the fleeing, disorganized enemy. Repeated torpedo runs completed the rout begun by the heavy guns. In total, 17 Russian warships out of the original fleet of 27 were destroyed, including seven battleships. Only three reached Vladivostok.





"CROSSING THE T"
The battle line of Japanese warships, with Admiral Togo's flagship *Mikasa* (see pp. 266–69) leading the fleet, wreaks destruction upon the Russians, triggering fires and explosions with its accurate gunnery.

PRE-DREADNOUGHT BATTLESHIP

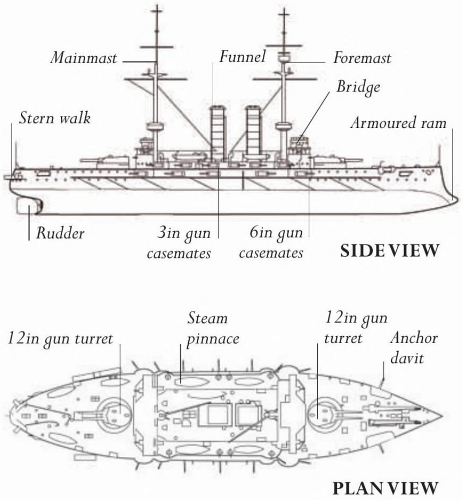
MIKASA

The only remaining example of a pre-dreadnought battleship, the *Mikasa* was the Japanese flagship at the Battle of Tsushima, in 1905 (pp.264–65), which saw the Imperial Russian fleet virtually annihilated.

Based on the Royal Navy's Majestic class, the *Mikasa* was the last of four similar battleships built in British yards for the Imperial Japanese Navy. Constructed by Vickers at Barrow-in-Furness, the *Mikasa* entered service on 1 March 1902.

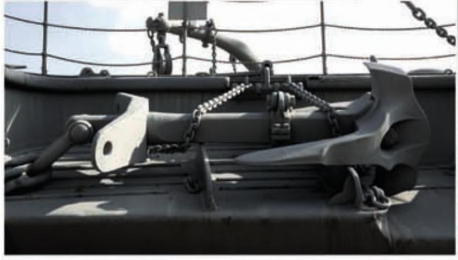
The ship's main armament consisted of four 12in guns, 40 calibres long, mounted in twin centre-line turrets fore and aft. These could be fired at a rate of three shots every two minutes. The *Mikasa*'s secondary armament included fourteen 6in quick-firing guns, lighter guns for defence against destroyers and torpedo-boats, and four submerged torpedo tubes.

The *Mikasa* was one of the first ships to have "Krupp Cemented" steel armour. In addition to forming the main deck, this armour was fitted in belts around the waterline up to 23cm (9in) thick, and in 356mm- (14in-) thick "barbettes" around the 12in gun installations. The armour proved effective at Tsushima, when some 30 hits from Russian guns failed to put the *Mikasa* out of action. Ironically, the ship sank in harbour four months later after an accidental explosion in a magazine. Although raised in 1906 and repaired, the *Mikasa* never saw combat again and was decommissioned in 1923. It is now a museum ship at Yokosuka.

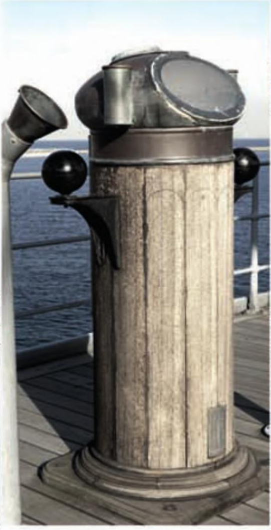


▲ ***MIKASA***
About 132m (432ft) long and displacing 15,180 tons, the *Mikasa* was powered by two triple- expanding steam engines that gave a top speed of 18 knots.

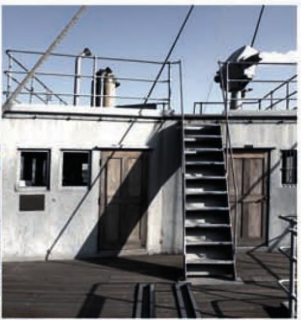
BRIDGE AND FORWARD



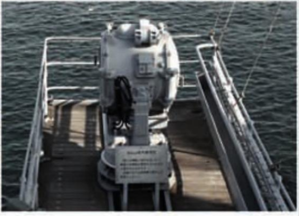
▲ **FORE ANCHOR**
Once raised, the anchor was returned to a platform just below upper-deck level, rather than to the hawsehole. It was brought there by a davit.



▲ **COMMAND POST**
Orders were given to the pilot house via a speaking tube *(left)* beside the compass.

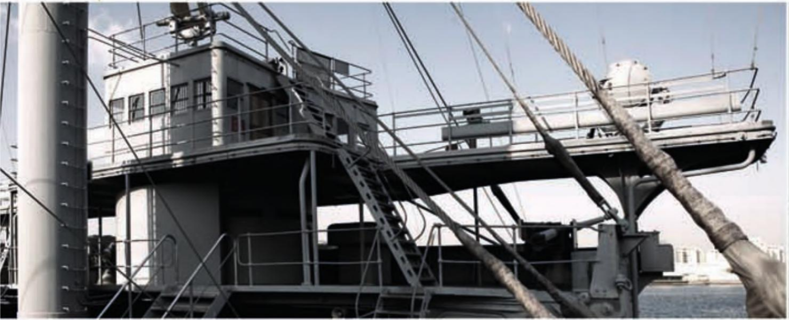


◀ **BRIDGE**
The pilot house (*left*) and chartroom (*right*) are topped by an open platform bearing a compass and range-finder. It was from here that, Admiral Togo Heihachiro commanded the Japanese fleet at Tsushima.



▲ **SEARCHLIGHT**
The wing searchlights were used to locate other vessels at night and for long-distance signalling.

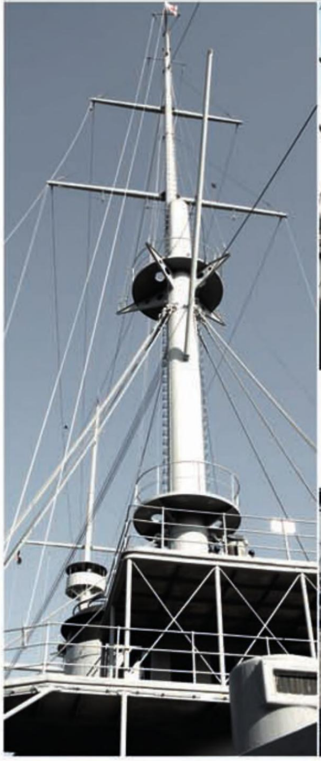
▼ **12IN GUN TURRET**
The *Mikasa*'s original 12in guns could fire a 385kg (850lb) projectile 13.5km (8½ miles). They were replaced by 45-calibre pieces during the 1906 rebuild.

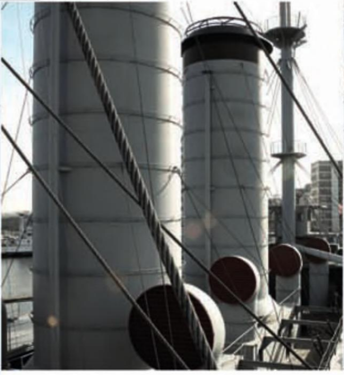


▲ **REAR VIEW OF BRIDGE**
Situated in front of the foremast, the bridge gives an uninterrupted view forwards and to each side. The long "wings" of the bridge, on which two 90cm (35in) electric searchlights are mounted, extend the full width of the ship.

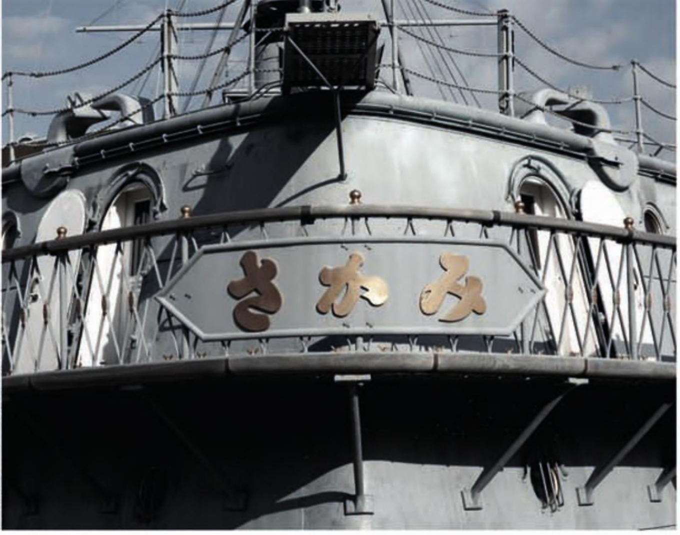
▲ **PORTHOLE**
Small glazed portholes, which could be sealed closed, were located only in unarmoured parts of the hull.

AMIDSHIPS AND AFT

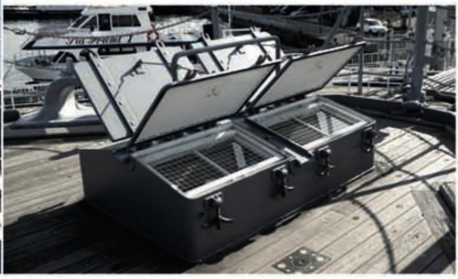




▲ **FUNNELS**
The flues from the *Mikasa*'s 25 coal-burning boilers connected to two tall, closely set vertical funnels.



▲ **STERN WALKWAY**
As always in such ships, the admiral's cabin was located in the very stern of the vessel, and was furnished with a private walkway. The gilded metal characters spell out the name "*Mi-ka-sa*" in hiragana script.

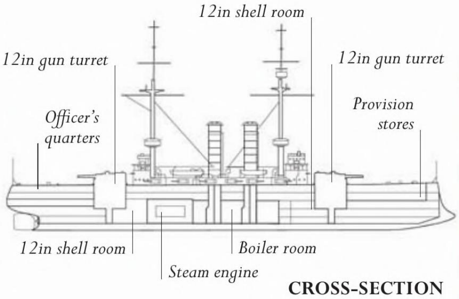


▲ **MAINMAST**
The two masts flew signals flags, supported radio antennae, and provided look-out positions.

▲ **AFT SKYLIGHT**
Shuttered skylights on the poop deck aft – and also the forecastle deck forwards – allowed light and fresh air into the living quarters below.

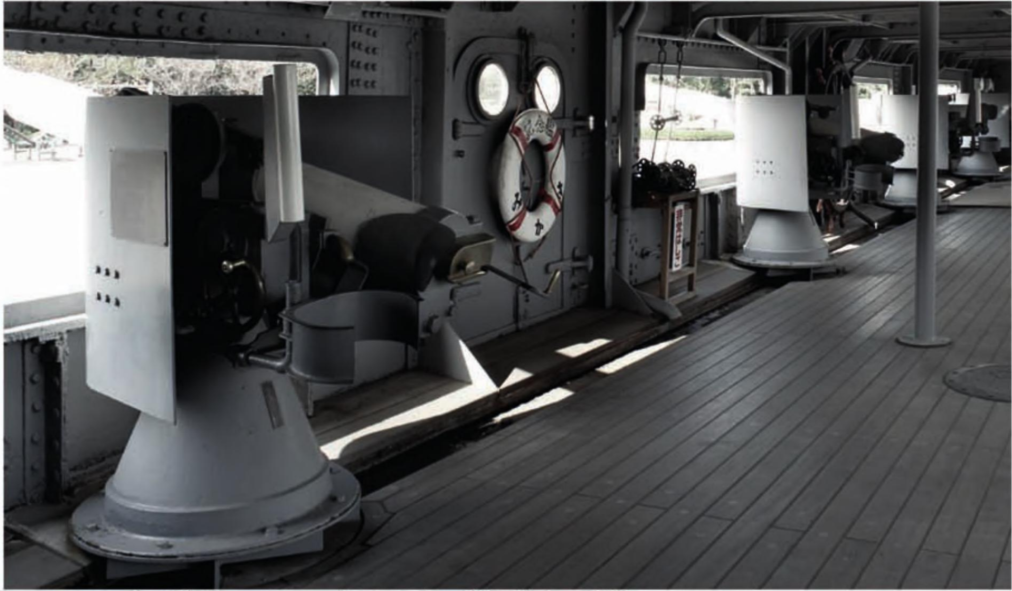
ARMAMENTS AND QUARTERS

To supplement its main armament, the *Mikasa* mounted a variety of smaller-calibre guns, from 6in ones for use against cruisers and destroyers, to 12, 3, and 1 pounders. There were also rifle-calibre machine guns. Living conditions were almost unchanged from the days of sail, with the men sleeping in hammocks and eating at fold-up tables.

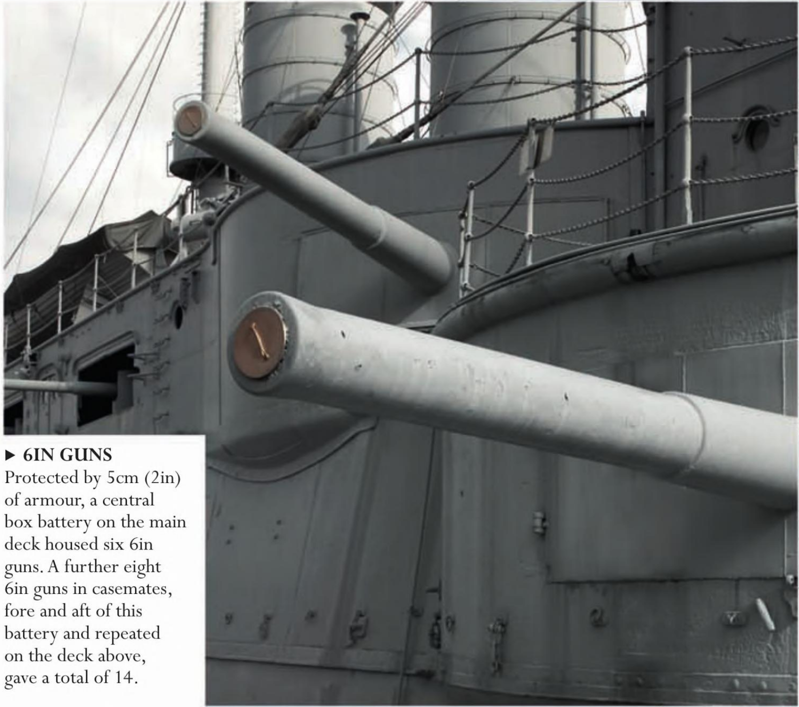


CROSS-SECTION

SMALLER GUNS



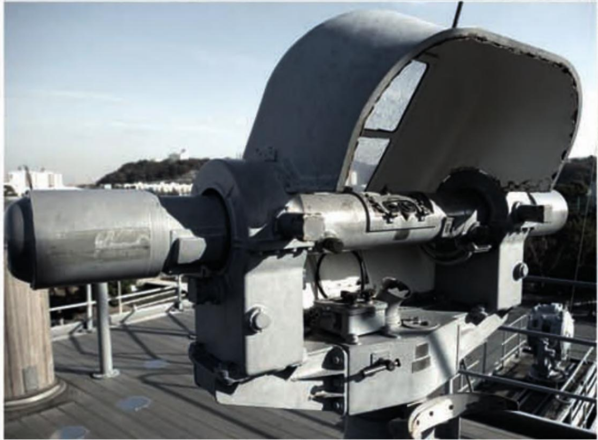
▲ 3IN GUN CASEMATE
Above the central 6in box battery were eight 3in quick-firing guns on pedestal mounts, with only light splinter-shields for protection.



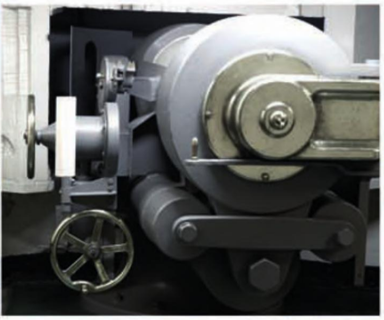
► 6IN GUNS
Protected by 5cm (2in) of armour, a central box battery on the main deck housed six 6in guns. A further eight 6in guns in casemates, fore and aft of this battery and repeated on the deck above, gave a total of 14.

◄ PORT TO 3IN BATTERY
It was through this port that the Russian second-in-command, Rear-Admiral Nikolai Nebogatov, boarded the *Mikasa* to surrender at Tsushima.

▲ HOTCHKISS 3-POUNDER GUN
These lightweight guns were mounted on simple pedestals, allowing the gunners to follow fast-moving targets such as torpedo-boats.

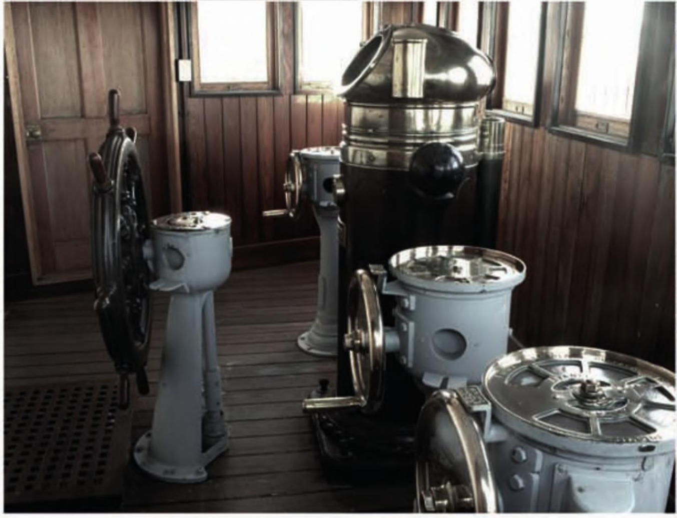


► RANGEFINDER
The *Mikasa*'s Barr & Stroud rangefinders were far superior to the types used by the Russian ships at Tsushima. They were decisive in the battle, giving the Japanese fleet long-range firepower superiority.



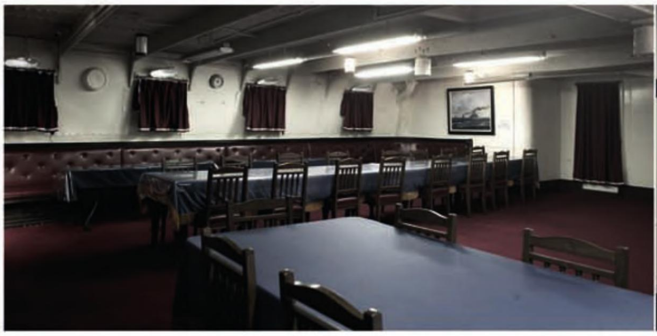
◄ 6IN GUN BREECH
The 6in guns were "quick-firers", their ammunition comprising both projectile and charge in a brass cartridge. They could fire up to six rounds per minute.

BELOW DECK



▲ **PILOT HOUSE**
The ship was "conned" (controlled) from here. The wheel, brass-mounted compass, and engine room telegraphs (used to indicate the speed required) were duplicated in an armoured conning tower one deck below.

▲ **PANTRY**
Food prepared below in the galley was brought up to the pantry, where it was plated-up by stewards to be served to officers in the wardroom.

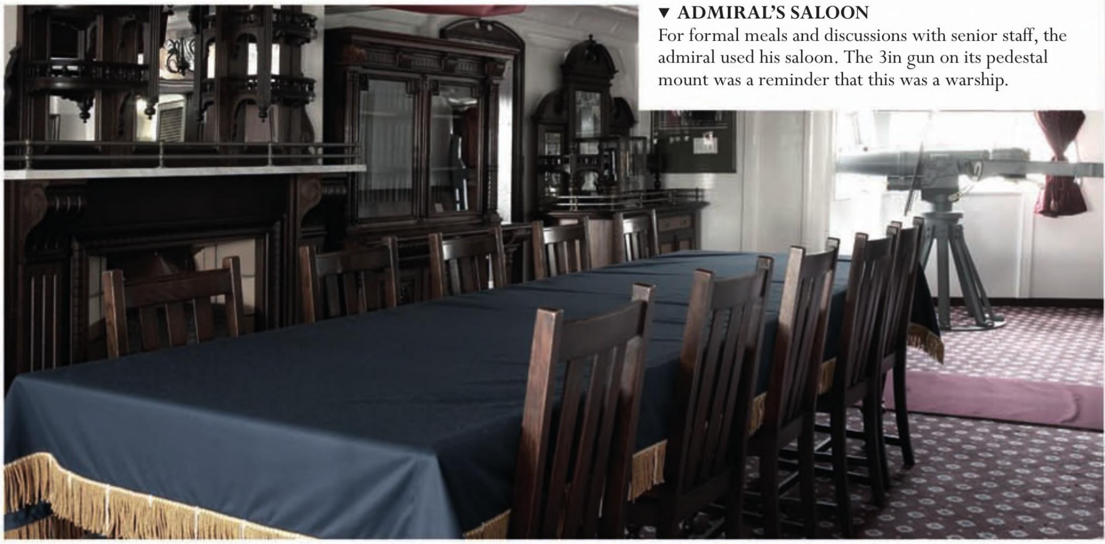


▲ **OFFICER'S WARDROOM**
As well as acting as the officer's dining room, the wardroom was used for meetings. The Imperial Japanese Navy had long adopted the European style of dining, even for ratings (non-officers).

▲ **ADMIRAL'S CABIN**
The admiral's quarters included a day cabin, where he worked, and a sparsely furnished night cabin with a high-sided bunk and limited storage space.

▲ **MORSE KEY**
Up-to-date wireless communication was another advantage the Japanese ships enjoyed at Tsushima.

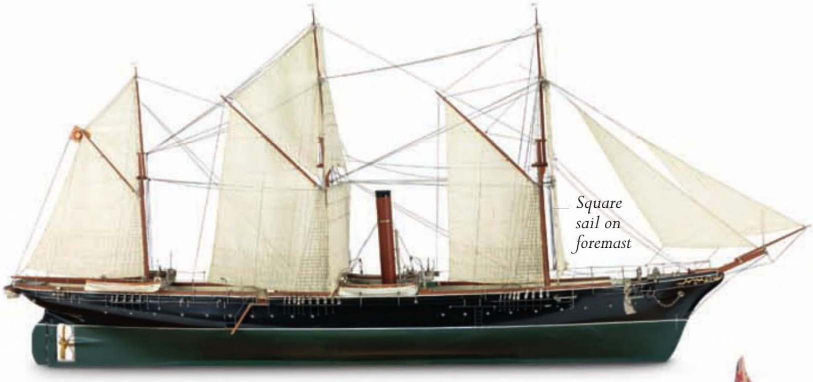
▼ **ADMIRAL'S SALOON**
For formal meals and discussions with senior staff, the admiral used his saloon. The 3in gun on its pedestal mount was a reminder that this was a warship.



▲ **ADMIRAL'S BATHROOM**
The unadorned "head" completed the admiral's quarters. Only he and the captain enjoyed such privacy.

EARLY CRUISERS

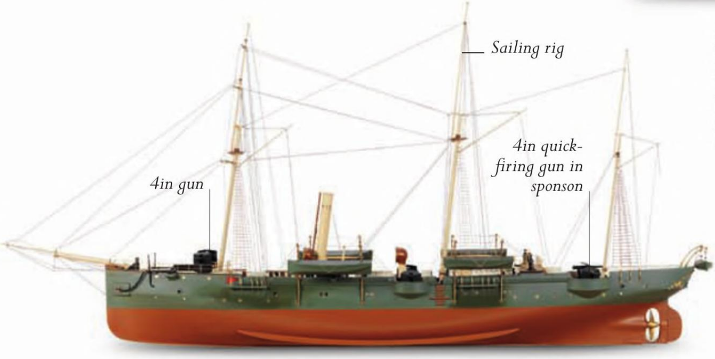
Prior to the 1880s, the term "cruiser" was not recognized as a single group of ships, being composed of frigates, corvettes, and sloops. By the 1890s, however, the new class had taken on a well-defined identity of its own. Capable of long-range action independently of battle fleets, cruisers were able to engage in commerce raiding or to protect national interests in far-flung places. By the turn of the century, cruisers had become the single largest class of warship in service; some navies never commissioned a more powerful, or modern, vessel.



▲ SEIKI

Commissioned	1876	**Origin**	Japan
Displacement	900 tons		
Length	61m (200ft)		
Top speed	9.5 knots		

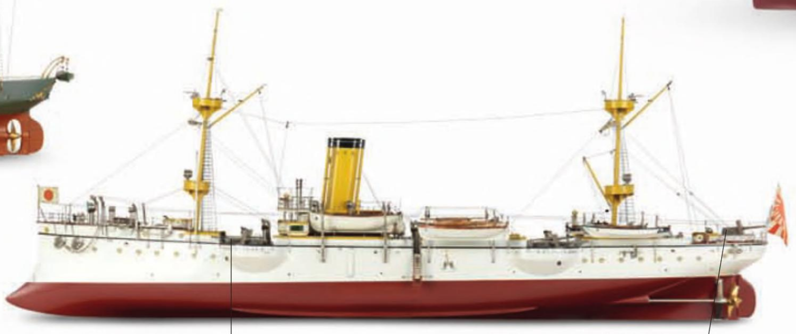
Barque-rigged (with square sails on the fore- and main masts and fore and aft on the mizzen) and wooden-hulled, the screw-sloop *Seiki* was the first ship built at the Yokosuka Navy Yard, to a French design.



▲ HMS RATTLER

Commissioned	1887	**Origin**	UK
Displacement	810 tons		
Length	50.3m (165ft)		
Top speed	13 knots		

A "composite gunboat", with wooden hull-planking on iron frames, the *Rattler* was one of a group of about 30 essentially similar general-purpose, small warships built between 1875 and 1890 for colonial service in Africa and Asia.



▲ TAKAO

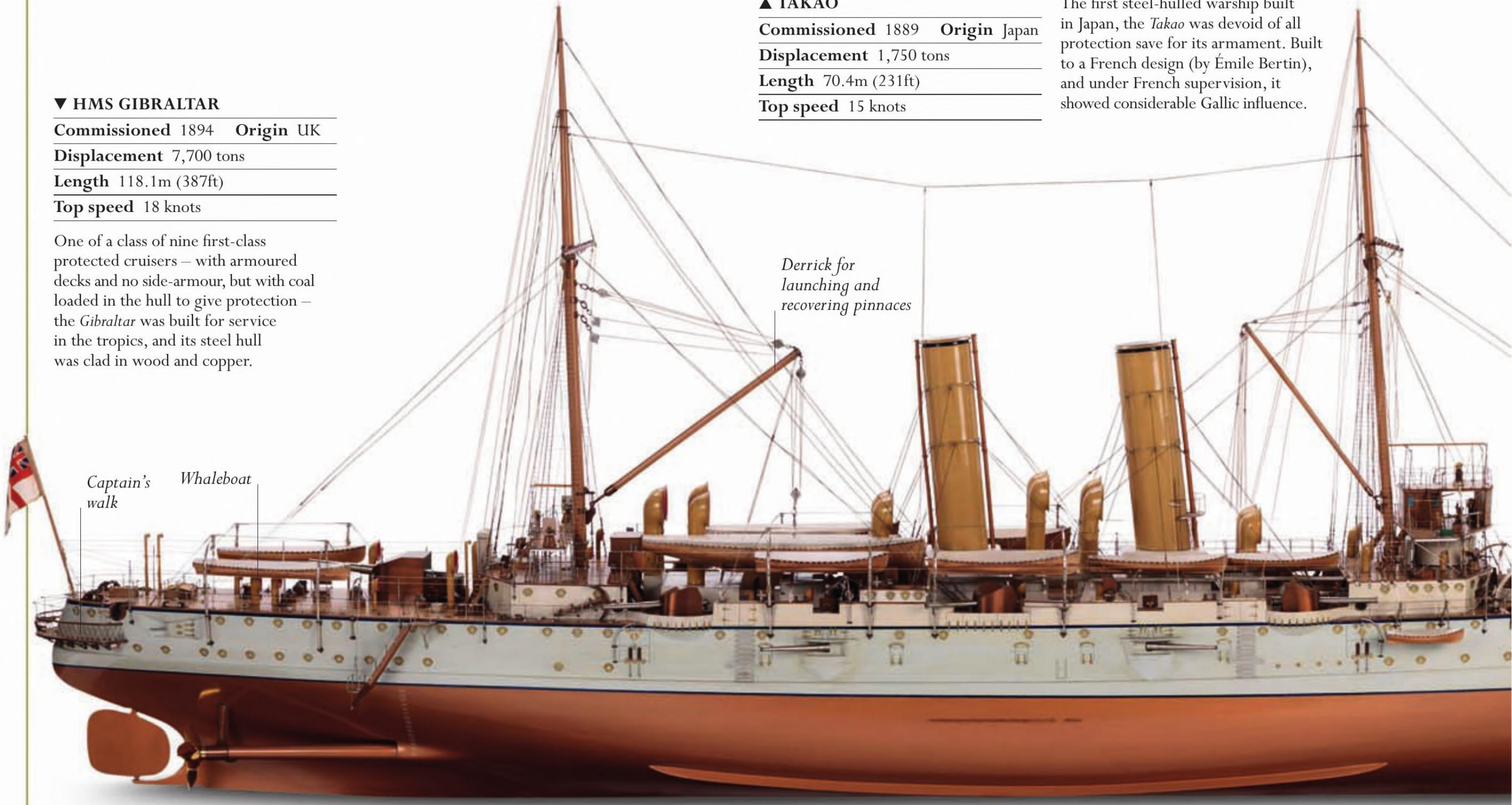
Commissioned	1889	**Origin**	Japan
Displacement	1,750 tons		
Length	70.4m (231ft)		
Top speed	15 knots		

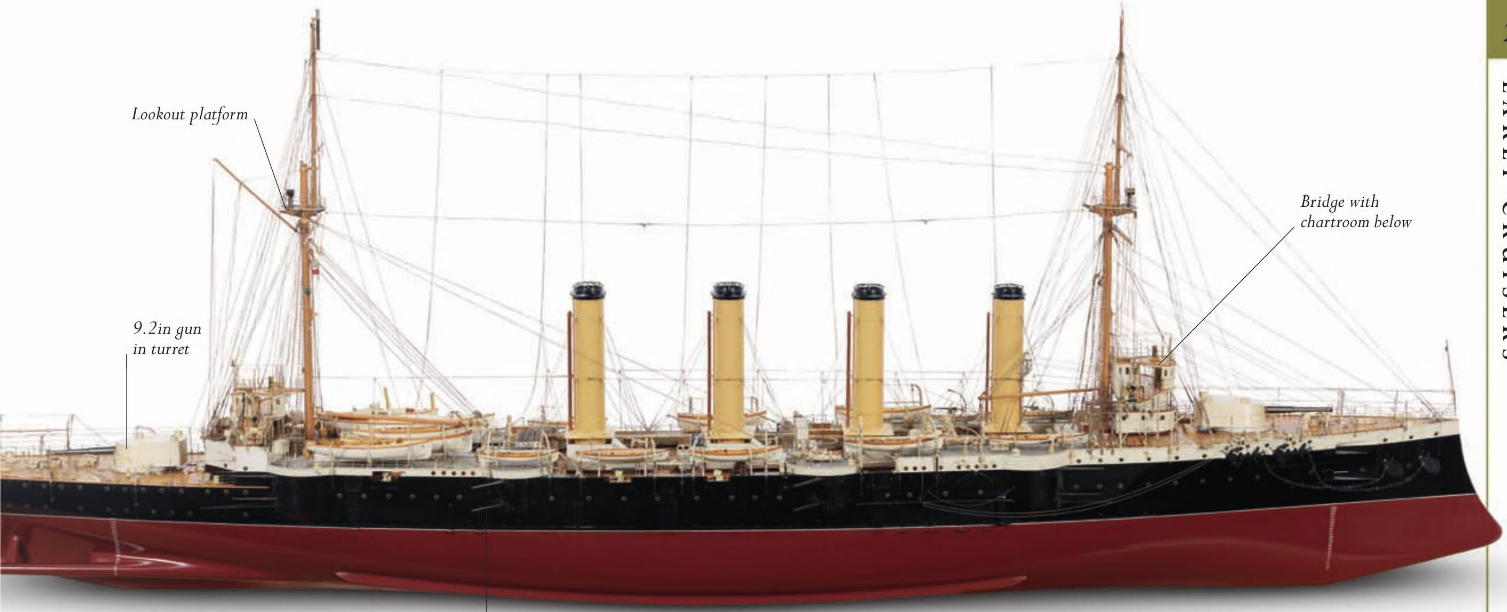
The first steel-hulled warship built in Japan, the *Takao* was devoid of all protection save for its armament. Built to a French design (by Émile Bertin), and under French supervision, it showed considerable Gallic influence.

▼ HMS GIBRALTAR

Commissioned	1894	**Origin**	UK
Displacement	7,700 tons		
Length	118.1m (387ft)		
Top speed	18 knots		

One of a class of nine first-class protected cruisers – with armoured decks and no side-armour, but with coal loaded in the hull to give protection – the *Gibraltar* was built for service in the tropics, and its steel hull was clad in wood and copper.




Lookout platform
9.2in gun in turret
Bridge with chartroom below
One of sixteen 6in guns in casemates

▲ HMS LEVIATHAN

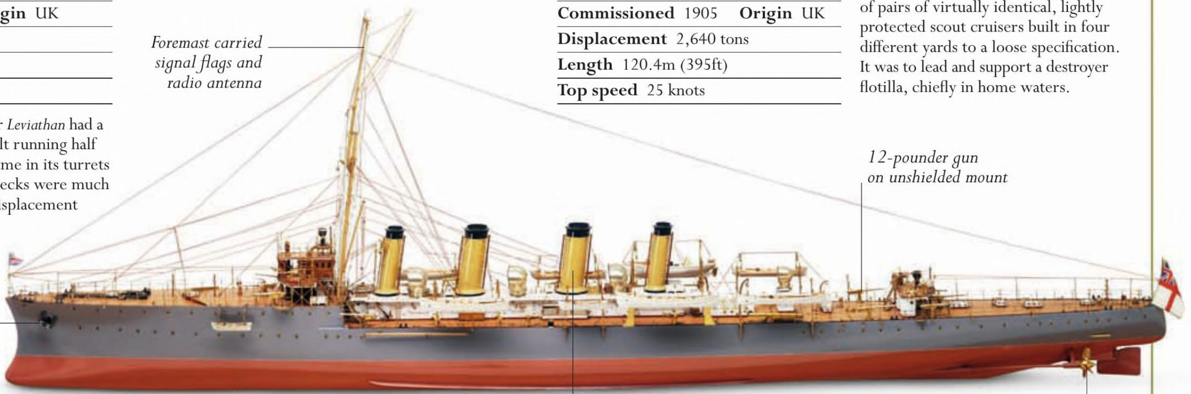
Commissioned 1903 **Origin** UK
Displacement 14,150 tons
Length 162.6m (533ft)
Top speed 23 knots

The first-class armoured cruiser *Leviathan* had a 15cm (6in) thick protective belt running half its length amidships, and the same in its turrets and barbettes. The armoured decks were much reduced in thickness to keep displacement within acceptable limits.

▼ HMS ADVENTURE

Commissioned 1905 **Origin** UK
Displacement 2,640 tons
Length 120.4m (395ft)
Top speed 25 knots

Adventure was the first in a sequence of pairs of virtually identical, lightly protected scout cruisers built in four different yards to a loose specification. It was to lead and support a destroyer flotilla, chiefly in home waters.

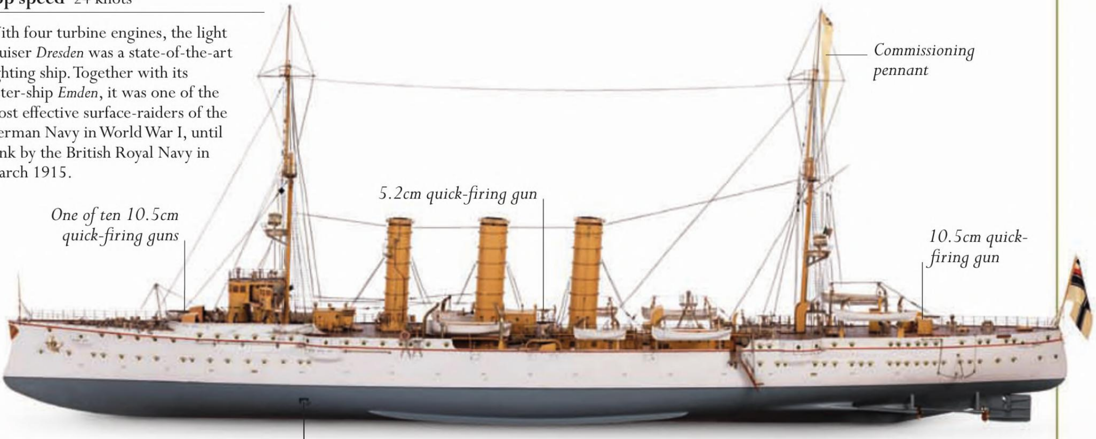

Foremast carried signal flags and radio antenna
12-pounder gun on unshielded mount
Anchor
12 boilers ducted to the four funnels
Two propellers driven by twin triple-expansion engines

▼ SMS DRESDEN

Commissioned 1908 **Origin** Germany
Displacement 4,270 tons
Length 117.9m (387ft)
Top speed 24 knots

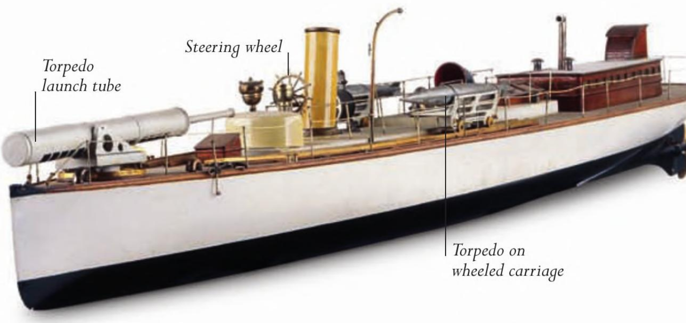
With four turbine engines, the light cruiser *Dresden* was a state-of-the-art fighting ship. Together with its sister-ship *Emden*, it was one of the most effective surface-raiders of the German Navy in World War I, until sunk by the British Royal Navy in March 1915.

One of ten 6in guns in casemates
Armoured ram bow


Commissioning pennant
5.2cm quick-firing gun
One of ten 10.5cm quick-firing guns
10.5cm quick-firing gun
Submerged torpedo tube

TORPEDO BOATS, DESTROYERS, AND SUBMARINES

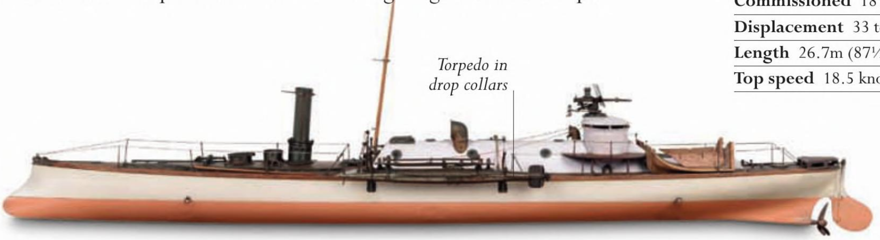
The perfection of the locomotive torpedo by English engineer Robert Whitehead at Fiume (modern-day Rijeka) in the 1860s changed the face of naval warfare forever. Craft were soon developed specifically to deploy the new weapon, leading to the production of torpedo-boat "destroyers" to combat the threat. Destroyers quickly established themselves as a valuable component of the fleet, taking over the torpedo boats' offensive role when necessary. The torpedo also proved vital to a third class of vessel, the submarine, as it provided submariners with a viable weapon for use when submerged against surface ships.



▲ LIGHTNING

Commissioned 1876 **Origin** UK
Displacement 33 tons
Length 26.7m (87½ft)
Top speed 18.5 knots

The first torpedo boat built for the British Royal Navy – at the urging of constructor John Thornycroft – was used as an experimental craft. It embodied a variety of innovative features including a divided rudder ahead of the propeller.

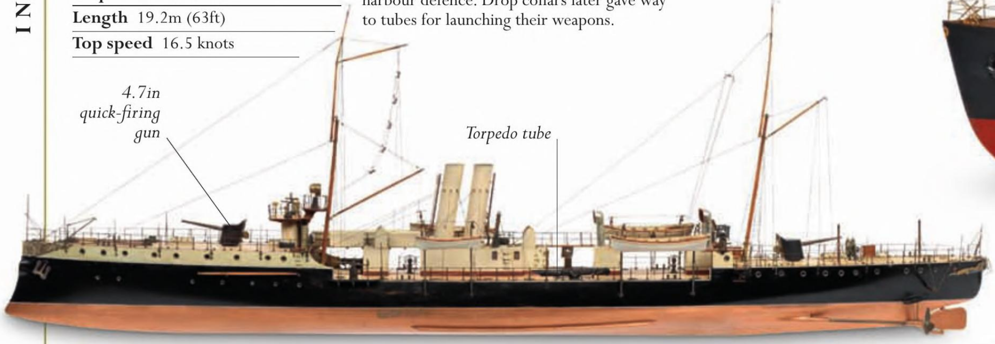


▲ TB 64

Commissioned 1880 **Origin** UK
Displacement 13 tons
Length 19.2m (63ft)
Top speed 16.5 knots

Second-class torpedo boats, such as the TB 64, were intended to be carried aboard battleships or large cruisers, but were also employed for harbour defence. Drop collars later gave way to tubes for launching their weapons.

4.7in quick firing gun on shielded mount



▲ ALMIRANTE SIMPSON

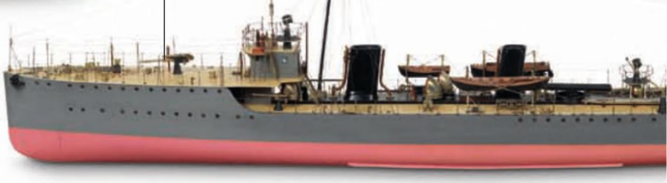
Commissioned 1896 **Origin** Chile
Displacement 800 tons
Length 73.2m (240ft)
Top speed 21.5 knots

Strictly speaking, *Almirante Simpson* was a torpedo gunboat, very similar in design, though not in looks, to the British Royal Navy's *Alarm*-class of 1894. This is not surprising given that it was also built by Laird in Birkenhead, England.

▼ HMS STURGEON

Commissioned 1896 **Origin** UK
Displacement 340 tons
Length 57.9m (190ft)
Top speed 27 knots

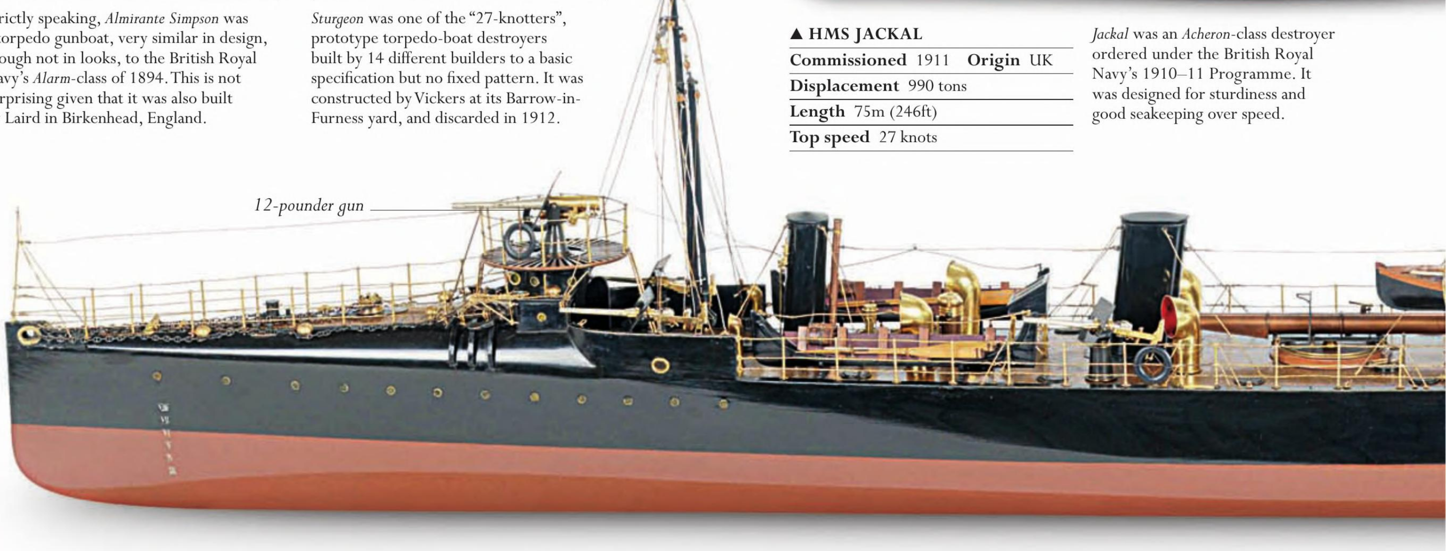
Sturgeon was one of the "27-knotters", prototype torpedo-boat destroyers built by 14 different builders to a basic specification but no fixed pattern. It was constructed by Vickers at its Barrow-in-Furness yard, and discarded in 1912.

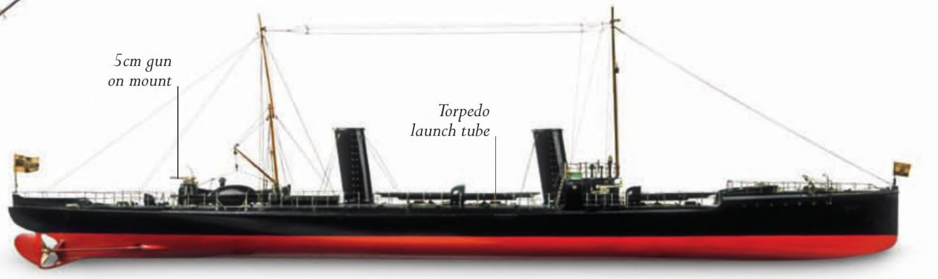


▲ HMS JACKAL

Commissioned 1911 **Origin** UK
Displacement 990 tons
Length 75m (246ft)
Top speed 27 knots

Jackal was an *Acheron*-class destroyer ordered under the British Royal Navy's 1910–11 Programme. It was designed for sturdiness and good seakeeping over speed.




5cm gun on mount
Torpedo launch tube

▲ SMS S101

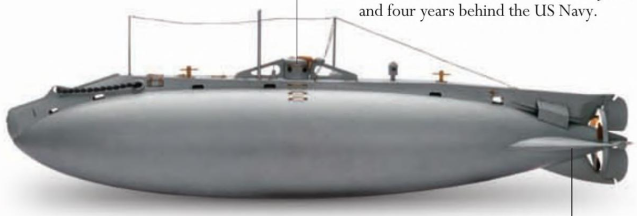
Commissioned 1901 **Origin** Germany
Displacement 388 tons
Length 63m (207ft)
Top speed 26.5 knots

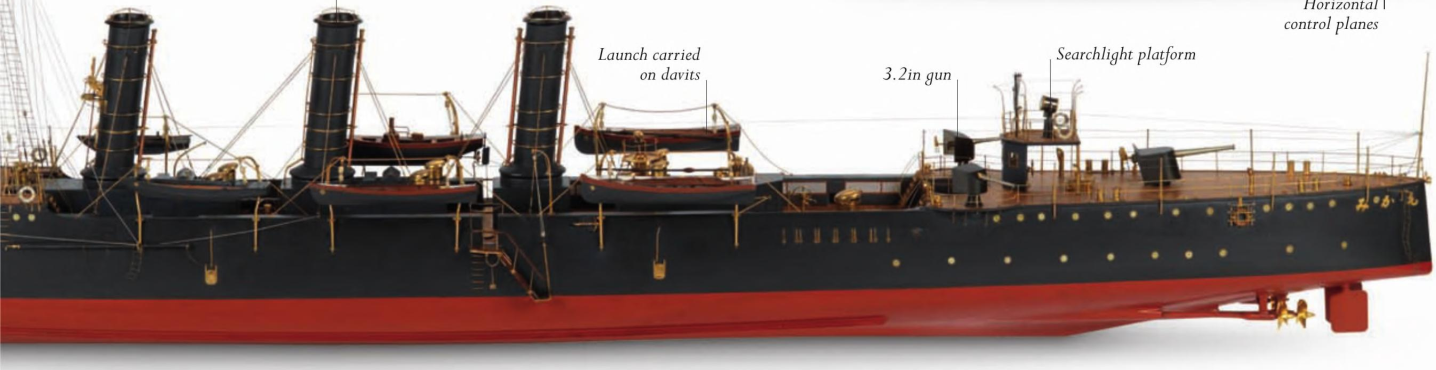
Although officially classed as destroyers, these Schichau-built vessels were, in effect, enlarged torpedo boats, their gun armament being extremely light. Those still in use in September 1914 were reclassified as such, and some were rearmed with 8.8cm guns.

▼ HMS HOLLAND NO. 1

Commissioned 1901 **Origin** UK
Displacement 113 tons (122 tons submerged)
Length 19.5m (64ft)
Top speed 7.5 knots

Britain's Royal Navy came late to submarines, the first such boats – built to an American design by Vickers at Barrow-in-Furness – being delivered 13 years after France commissioned its first, the *Gymnôte*, and four years behind the US Navy.


Access hatch
Horizontal control planes


Six boilers driving three Parsons turbines exhausted through three funnels
Launch carried on davits
3.2in gun
Searchlight platform

▲ MOGAMI

Commissioned 1908 **Origin** Japan
Displacement 1,350 tons
Length 96.3m (316ft)
Top speed 23 knots

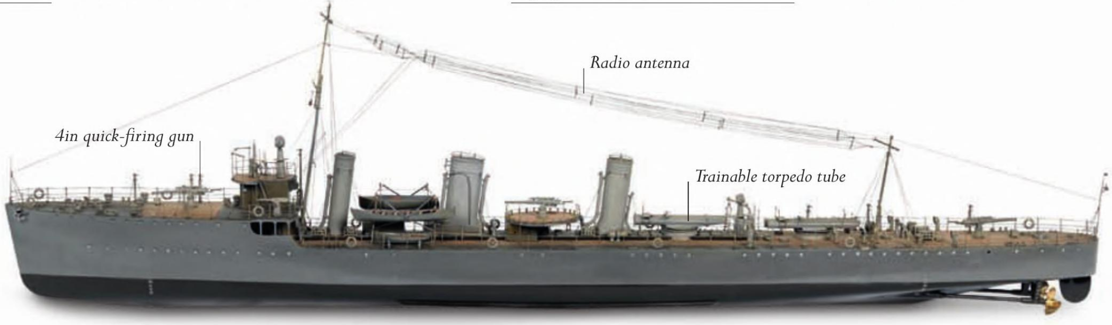
Officially classified as a "despatch vessel", and in fact a miniature protected cruiser, *Mogami* was the first turbine-engined Japanese warship. Its original function was rendered obsolete even before completion by the introduction of wireless telegraphy.

▼ HMS MASTIFF

Commissioned 1914 **Origin** UK
Displacement 1,100 tons
Length 83.6m (274ft)
Top speed 35 knots

By 1914, destroyers had increased considerably in both size and speed. Several of the *M*-class ships were built experimentally, and *Mastiff* was said to be the fastest warship afloat following her sea trials.

Torpedo launch tubes


Radio antenna
4in quick-firing gun
Trainable torpedo tube

Trainable torpedo launch tube

1914–1945

THE WORLD WARS

104

INTRODUCTION

The two world wars, from 1914 to 1918, and from 1939 to 1945, were the most destructive conflicts in human history. In terms of technology, the period was marked by the spectacular development of aviation and of motorized warfare, especially tanks.

The pace of development was by no means even. Infantry firepower increased over time, from the introduction of light machine-guns and mortars, to sub-machine-guns, automatic rifles and, late in World War II, assault rifles. But there is no comparison between this scale of change and the absolute transformation of aerial warfare. Armies entered World War I with a few hundred flimsy, unarmed reconnaissance aircraft. By 1945, however, fleets of thousands of multi-engined bombers were able to devastate enemy cities, while ground forces could barely operate if their opponents controlled the skies. Dominance in naval battles shifted from large battleships to aircraft carriers, while submarines established themselves, unexpectedly, as potentially war-winning commerce raiders.

The tank, a useful – if clumsy – adjunct to World War I infantry operations, was vital to the fast-moving motorized warfare of World War II, when coordinated by radio with ground-attack aircraft serving as aerial artillery. The motor truck eventually made horse-drawn transport obsolete, although, as late as 1941, Germany still used hundreds of thousands of horses for its invasion of the Soviet Union.

The pressure of war generated a search for "wonder weapons", as scientists were enlisted to help the military effort. Poison gas proved indecisive in World War I, and chemical weapons were not used between 1939 and 1945. The jet aircraft, V-1 flying bomb, and V-2 ballistic missile were all introduced by Germany late in World War II, without affecting the outcome of the conflict; however, the atom bomb, developed by the United States between 1942 and 1945 at vast cost, truly heralded a new era in warfare.

KEY DATES

1914

August 1914 World War I begins

September 1914 A German U-boat sinks three British cruisers in one hour

December 1914 On the Western Front, opposing armies are dug into static trench warfare

April 1915 The Germans introduce poison gas at the Second Battle of Ypres

May 1915 German Zeppelin airships carry out the first bombing raid on London

June 1915 The interrupter gear allows a pilot to fire through the arc of his propeller, making air combat practical

July 1916 At the opening of the Battle of the Somme, the British Army suffers almost 60,000 casualties in a day

September 1916 The first tanks are used in warfare by the British, at Flers-Courcelette, in France

April 1917 The United States enters World War I, in response to German U-boats sinking merchant ships

November 1918 World War I ends with the defeat of Germany

1921 Italian General Giulio Douhet publishes *The Command of the Air*, saying wars can be won through strategic bombing

1922 The Japanese ship *Hosho* is the first purpose-built aircraft carrier

May 1935 The Messerschmitt Bf109 is the first of a new generation of high-performance fighter aircraft

September 1935 The British government plans to build a chain of air defence radar stations

April 1937 In the Spanish Civil War, aircraft of the German Condor Legion bomb the Basque town of Guernica

August 1939 In Germany, the Heinkel He 178 makes the first experimental jet flight

THE BATTLE OF VERDUN – 1916

THE BATTLE OF ARRAS – 1917

US GROUND FORCES – c.1943

September 1939 World War II begins in Europe

April 1940 The Germans drop parachute troops during their invasion of Norway

May–June 1940 The German army defeats the British and French using "Blitzkrieg" tactics

June 1940 The Battle of Britain begins – the first battle fought exclusively in the air

September 1940 German aircraft bomb London, opening the Blitz, which went on until May 1941

June 1941 Germany and its allies invade the Soviet Union, in Operation Barbarossa

December 1941 A strike by Japanese naval aircraft devastates the US fleet at Pearl Harbor, in the Pacific

June 1942 The Battle of Midway is fought between American and Japanese aircraft carriers in the Pacific

February 1943 After months, Soviet troops win a decisive victory at Stalingrad

July 1943 Allied bombers destroy the German city of Hamburg, killing 40,000 people

July–August 1943 The largest tank battle of World War II is fought at Kursk, on the Eastern Front, between the Soviet Union and Germany

June 1944 The D-day landings in Normandy are the world's largest amphibious operation

June 1944 German V-1 flying bombs strike London, England

September 1944 Germany attacks Allied cities with V-2 ballistic missiles

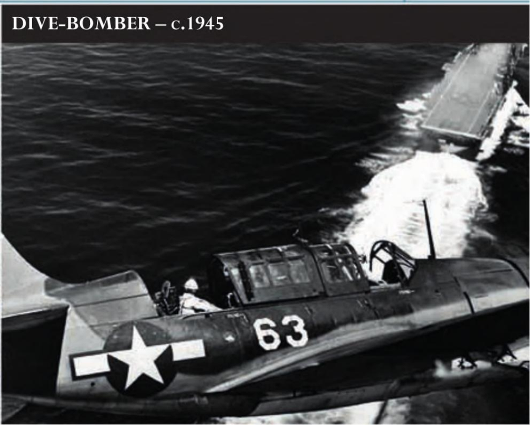
April–May 1945 Soviet troops occupy the German capital, Berlin, ending World War II in Europe

August 1945 The United States drops atom bombs on the Japanese cities of Hiroshima and Nagasaki

1945

THE BATTLE OF LEYTE GULF – 1944

THE BOMBING OF DRESDEN – 1945


DIVE-BOMBER – c.1945

KEY **BATTLE**

BATTLE OF VERDUN

1916

In February 1916, the Germans attacked the French trenches at Verdun, firing over a million shells in their preliminary bombardment. A battle of attrition followed, in which more than 500,000 men died, with little gain to either side.

▲ French soldiers advance across no-man's-land, in a 1928 film recreating the infantry assault at Verdun.

▼ PASSCHENDAELE
Australian soldiers advance across duckboards during the Battle of Passchendaele, on the Western Front, in 1917. Artillery shells and wet weather combined to create nightmarish fighting conditions, with movement hampered by thick mud and deep, water-filled craters.

KEY DEVELOPMENT

TRENCH WARFARE

World War I (1914–18) was industrialized conflict on a massive scale, with factories supplying weapons and munitions for armies totalling millions. Trench warfare, born out of this new, large-scale firepower, favoured the defenders, especially if they were protected behind barbed wire.

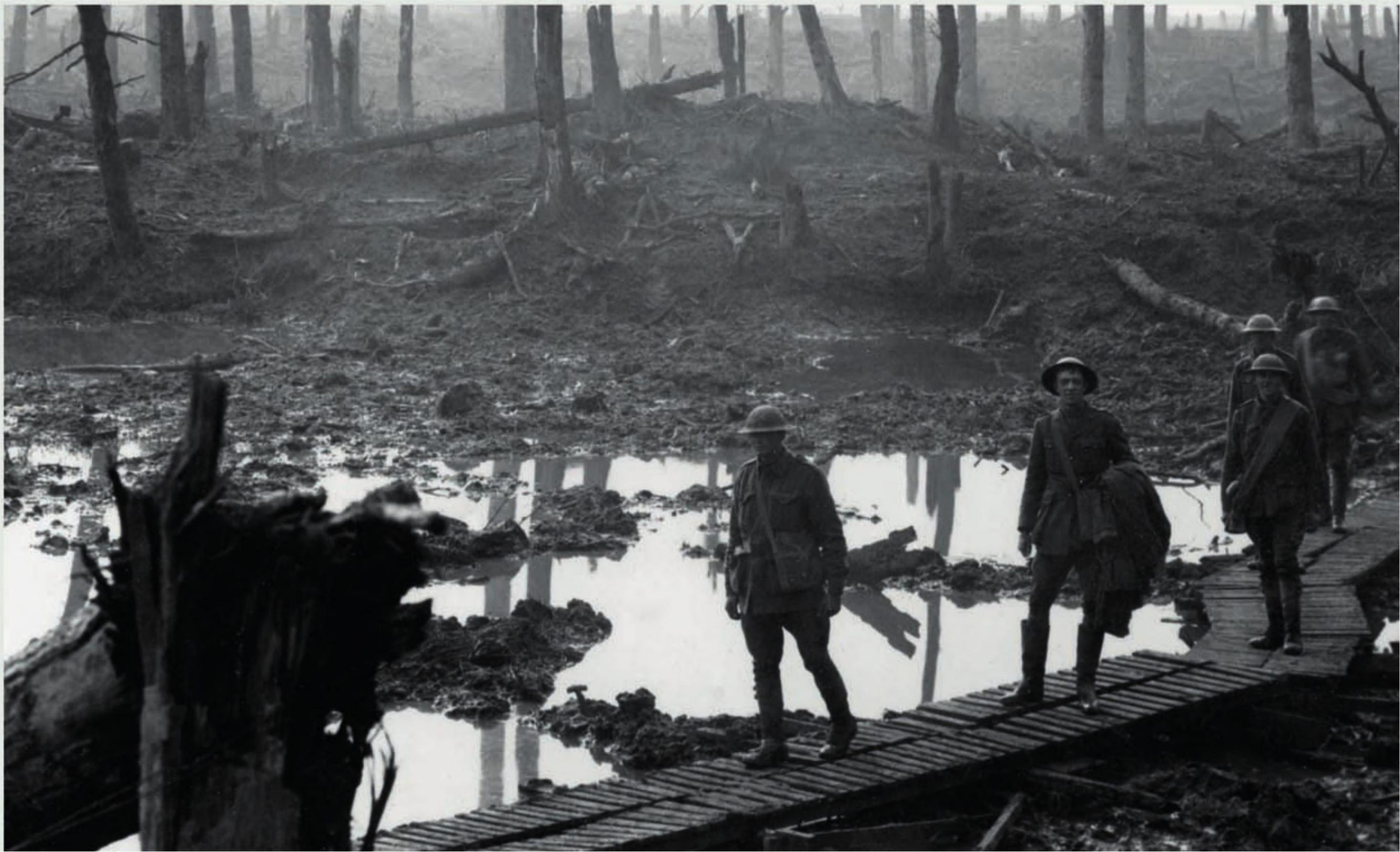
By 1915, a double line of trenches stretched across France and Belgium, with troops facing one another across no-man's-land. This new kind of field fortification was a response to increasing artillery and infantry firepower, as was the adoption of steel helmets by all armies. Trenches developed into elaborate defence systems: the Germans in particular constructed complexes of concrete bunkers and concealed machine-gun nests that extended for miles behind the front line (see pp.286–87).

ATTACK AND DEFENCE

Offensives in the initial stages of trench warfare involved a sustained preliminary artillery bombardment – designed to destroy enemy defences by sheer quantity of high-explosive shells – followed by a frontal infantry assault. Often, however, the defenders survived the bombardment, and slaughtered the attackers as they tried to cross no-man's-land, using machine-guns and rapid-fire rifles. Even when enemy front-line trenches were captured, assaults floundered as the attackers pushed further forward over ground that had been churned up by shells. The advancing troops could no longer communicate with their own lines by field telephone, with the result that the defenders were often able to move reserves to a danger spot quicker than the attackers could reinforce their offensive. Cavalry units, the only forces capable of rapid movement, were highly vulnerable to infantry and artillery fire, and hampered by barbed wire and shell craters.

BREAKING THE DEADLOCK

Commanders began to seek technological solutions to address or overcome the stalemate of trench warfare. The Germans introduced poison gas, which was first pumped from cylinders and later delivered by artillery shells. Used by both sides,



◂ **CANADIAN TROOPS GO "OVER THE TOP"**
The moment of climbing out of the frontline trench to advance on the enemy – known as going "over the top" – was dreaded by every infantryman. Junior officers traditionally led the way into no-man's-land, themselves unarmed or carrying only a pistol.

KEY **EVENTS**

1914–18

- **November 1914** After an initial phase of mobile warfare, the armies on the Western Front settle into entrenched positions.
- **April 1915** The Germans make the first effective use of poison gas, releasing chlorine from cylinders against unprotected French colonial and Canadian troops at the Second Battle of Ypres.
- **July 1916** On the first day of the Somme offensive, British troops suffer more than 57,000 casualties, including 19,000 killed.
- **June 1917** At Messines, 19 mines explode simultaneously in tunnels dug under German lines, killing 10,000 and allowing a British advance.
- **November 1917** Massed British tanks help infantry achieve a breakthrough at Cambrai, although the opportunity is not exploited.
- **March 1918** German forces, spearheaded by Stormtroopers, achieve a major breakthrough in the Michael offensive. Mobility returns to the war, which ends in the defeat of Germany, in November.

gas claimed many thousands of lives and contributed to the general misery of trench life, but it had no decisive effect.

The British placed great faith in tanks. These slow-moving armoured vehicles advanced in front of the infantry in many offensives from 1916 onwards. However, their effectiveness was limited by their tendency to break down and, in spite of their heavy armour, their vulnerability to artillery fire.

In the end, trench warfare was transformed by a gradual evolution of artillery and infantry tactics, integrating new technology in effective ways. Aerial observation from aircraft and tethered balloons, linked to the ground by radio, improved the targetting of big guns. Flash-spotting and sound-ranging techniques allowed gunners to pinpoint and destroy enemy batteries, based on the sight and sound of their gunfire. The tight coordination of artillery and infantry was crucial to the "rolling barrage" – a curtain of supporting shellfire advancing only 50m (165ft) ahead of the soldiers. Light machine-guns, grenades, portable mortars, and flame-throwers improved the armament of attacking troops, while German elite Stormtroopers used shock assault tactics to punch holes in enemy defences. In 1918, Germany's assault on Allied trenches – and its eventual failure – signalled the end of trench warfare in World War I.

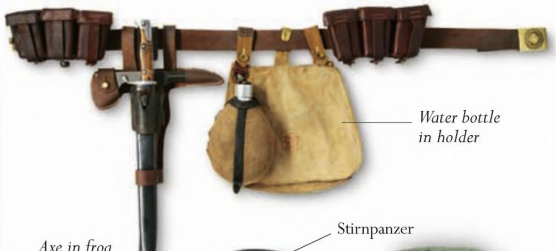
◂ **A GERMAN GAS MASK**
Developed during the war in response to chemical attacks, gas masks had goggles to protect the eyes and a chemical breathing filter that neutralized harmful substances. Poison gases used in the war included chlorine, phosgene, and mustard gas.

> "[The regiment's] assault **failed of success** because **dead men** can advance no further"

GENERAL BEAUVOIR DE LYLE, ON THE NEWFOUNDLAND REGIMENT, 1 JULY 1916

UNIFORMS AND EQUIPMENT

Until the latter years of the 19th century, a soldier went into battle wearing the same colourful outfit he wore on the parade ground, but this changed with the advent of revised infantry tactics. The need for concealment led to the adoption of khaki, field-grey, and similar neutral tones. Protective body armour, which was abandoned when plate and mail proved vulnerable to bullets, was not to return until the development of flak jackets in World War II.



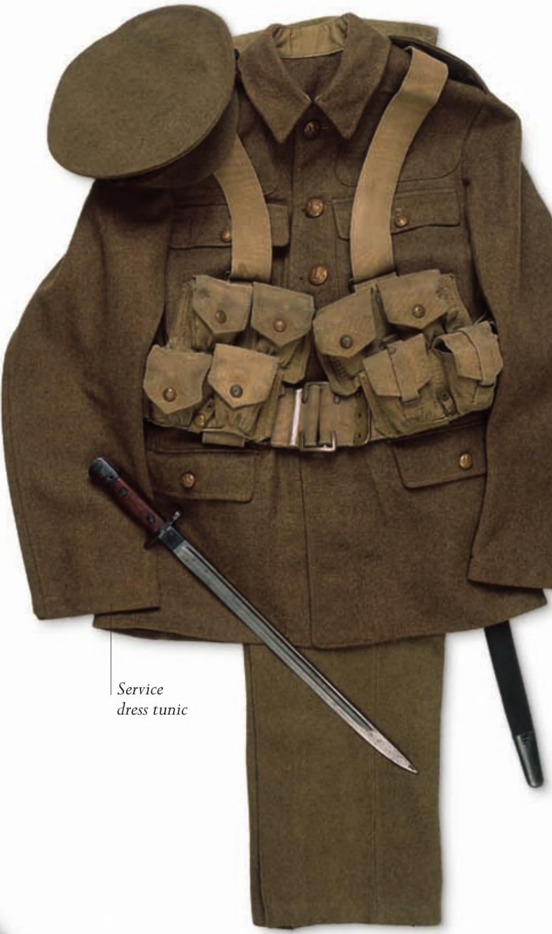
◀ STORM TROOPER EQUIPMENT

Date 1916

Origin Germany

Material Leather, cotton, brass

German storm troopers were issued with a belt kit that included bags for grenades to supplement ammunition pouches, frogs to hold an axe and the favoured short bayonet-cum-trench knife, and a water bottle.



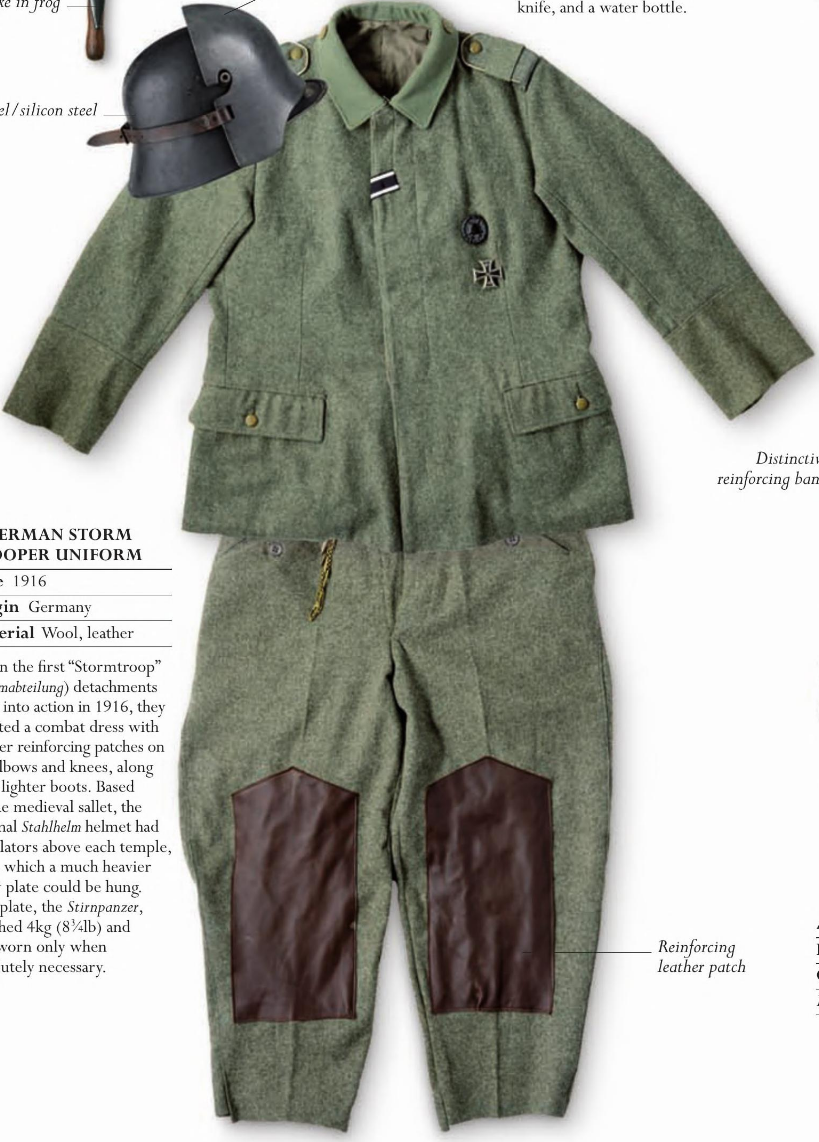
▶ BRITISH UNIFORM

Date 1902

Origin UK

Material Wool

British troops in India took up khaki uniforms as early as the 1850s. They were formally adopted in 1897, and the darker shade shown here came into use in 1902. Also shown is the belt of the 1908-pattern webbing system, with ammunition pouches and a bayonet "frog" – a strap for suspending an item from the belt.



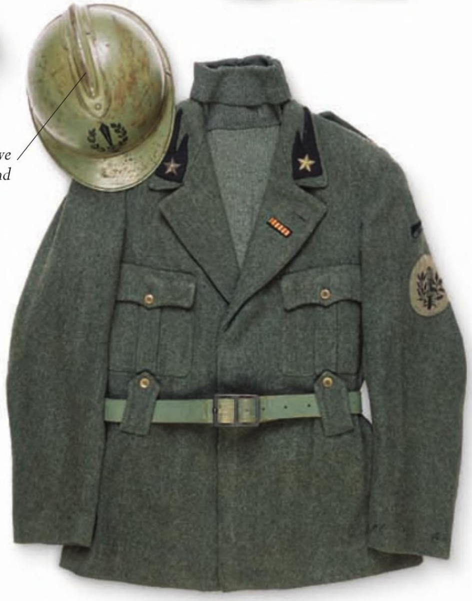
▶ GERMAN STORM TROOPER UNIFORM

Date 1916

Origin Germany

Material Wool, leather

When the first "Stormtroop" (*Sturmabteilung*) detachments went into action in 1916, they adopted a combat dress with leather reinforcing patches on the elbows and knees, along with lighter boots. Based on the medieval sallet, the original *Stahlhelm* helmet had ventilators above each temple, from which a much heavier brow plate could be hung. This plate, the *Stirnpanzer*, weighed 4kg (8¾lb) and was worn only when absolutely necessary.



▲ ITALIAN UNIFORM

Date 1915

Origin Italy

Material Wool, steel

Italy switched to a grey-green uniform, similar to the German *feldgrau*, in 1915. The army also adopted a steel helmet similar to the French "Adrian", with its reinforcing band running back across the crown.

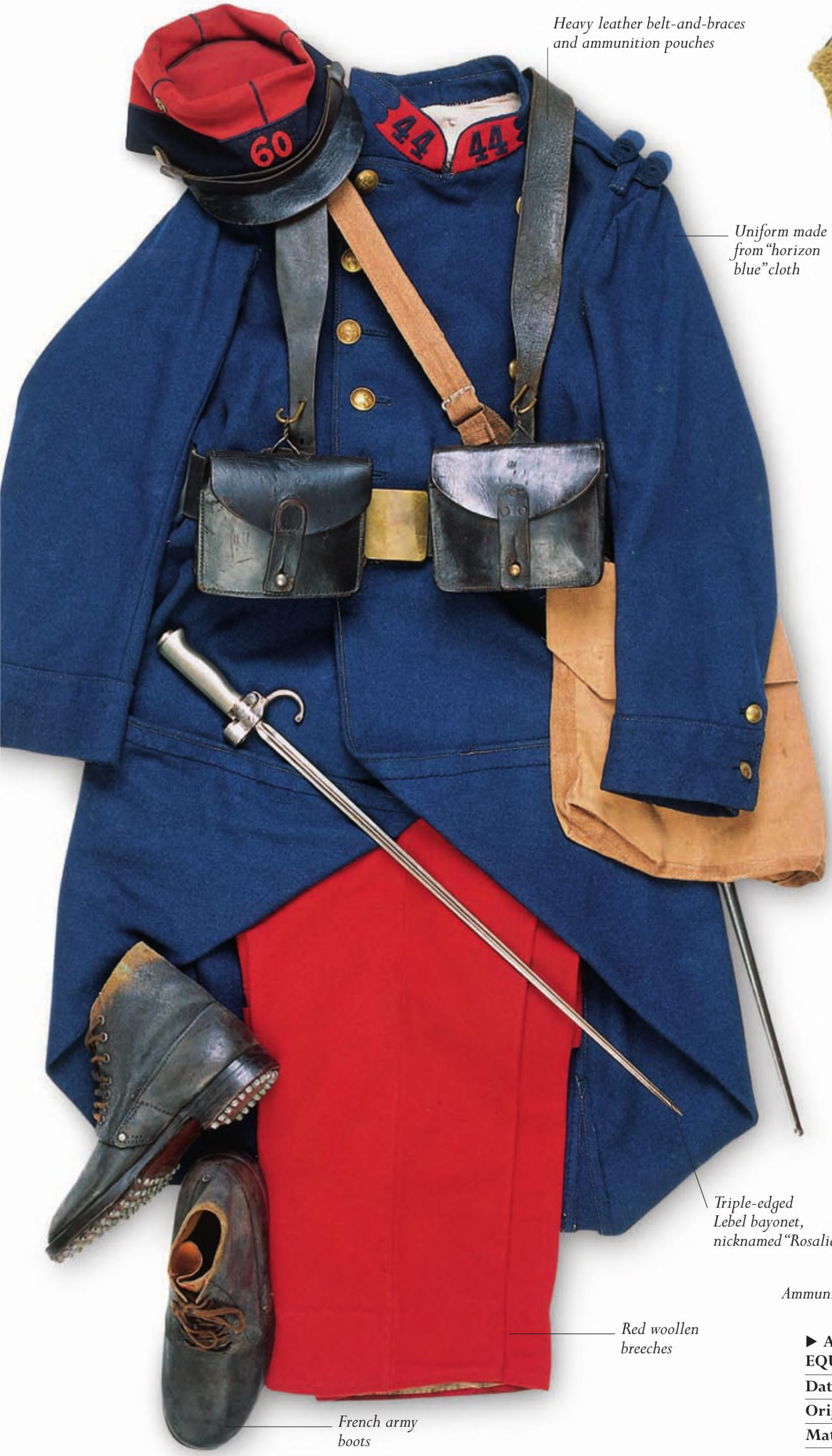
▼ FRENCH UNIFORM

Date Up to 1915

Origin France

Material Wool, leather, brass

The French army was one of the last to give up its brightly coloured field uniform – red breeches and a long-tailed blue coat – in favour of drab colours. Conversely, it was the first to adopt a steel helmet in place of the cloth *képi*.



Heavy leather belt-and-braces and ammunition pouches

Uniform made from "horizon blue" cloth

Triple-edged Lebel bayonet, nicknamed "Rosalie"

Red woollen breeches

French army boots

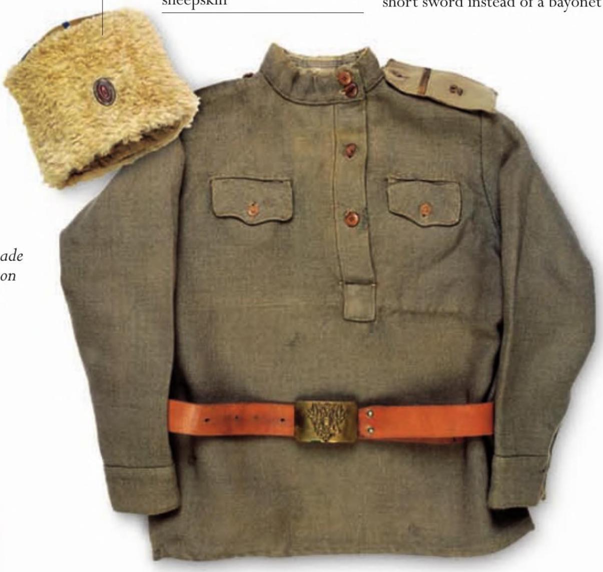
▼ RUSSIAN UNIFORM

Date 1914

Origin Russia

Material Wool, leather, sheepskin

Russia adopted light brown for its field uniform in 1907. Cossack units continued to wear the traditional sheepskin *Papakha* hat, while artillerymen were issued a short sword instead of a bayonet.



Sheepskin Papakha *hat*

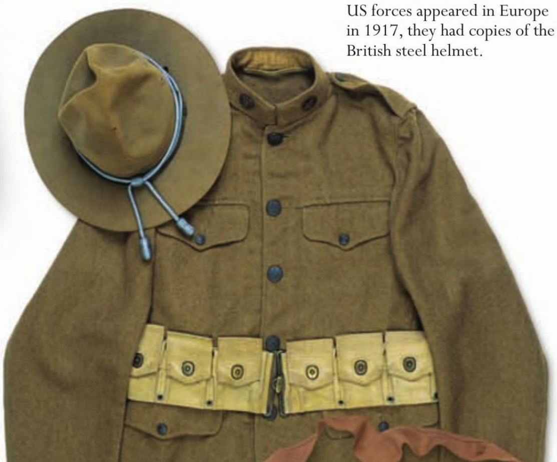
▼ AMERICAN UNIFORM

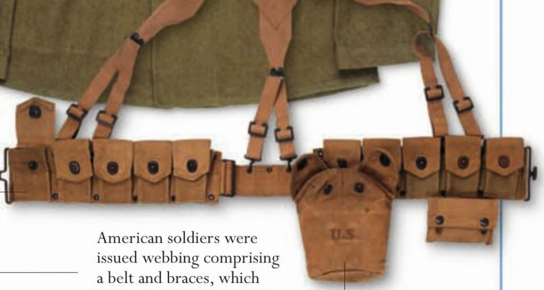
Date 1917

Origin US

Material Wool

The US Army introduced olive uniforms in 1902, although some troops had worn the colour in the Spanish-American War of 1898. The hat was a hangover from earlier times, but when US forces appeared in Europe in 1917, they had copies of the British steel helmet.





Ammunition pouch

Water-bottle holder

▶ AMERICAN EQUIPMENT

Date 1917

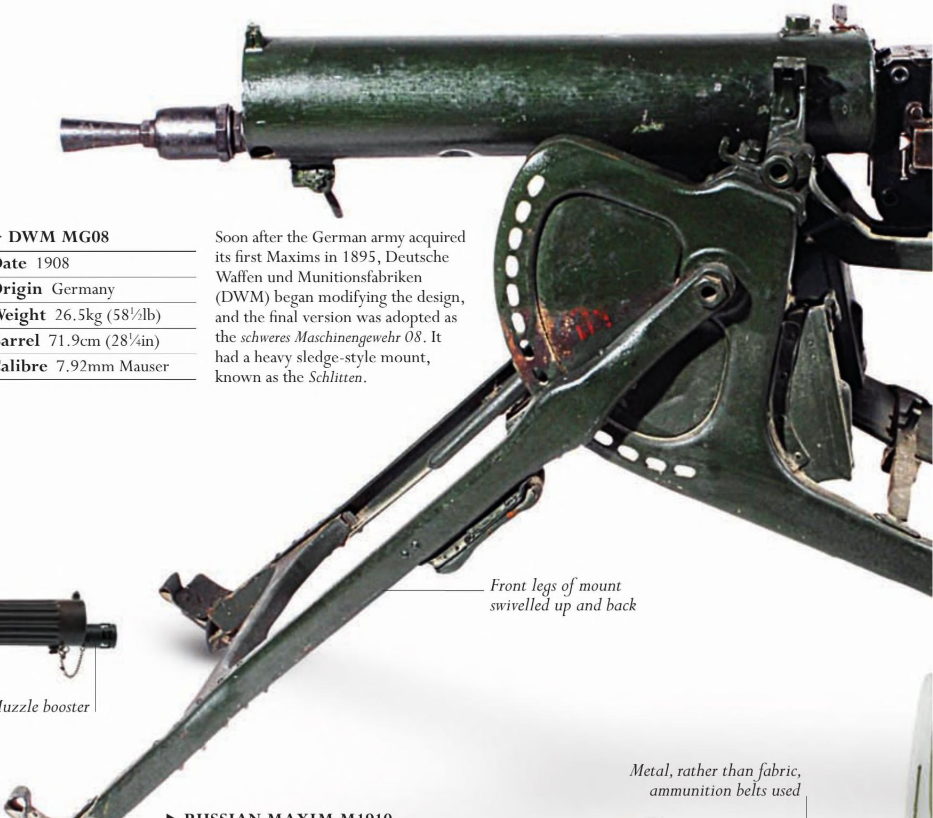
Origin US

Material Cotton, brass

American soldiers were issued webbing comprising a belt and braces, which held ammunition pouches and a water-bottle holder, plus a bayonet frog.

HEAVY MACHINE-GUNS

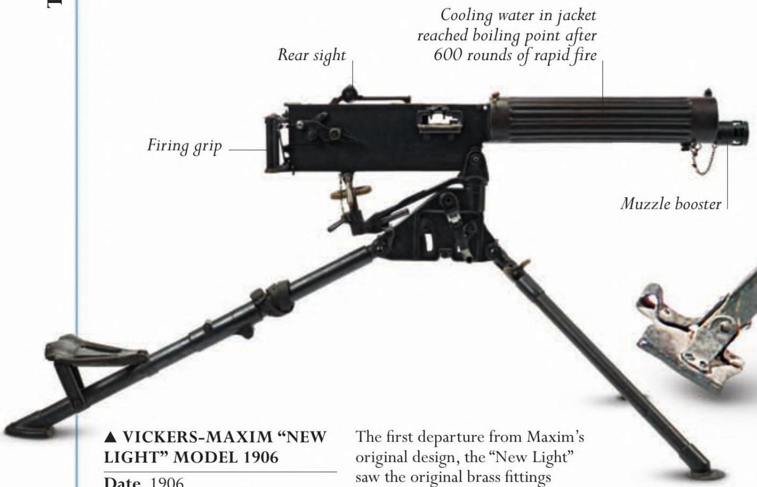
The most significant and deadly weapons used on the battlefield in World War I, "heavy" machine-guns accounted for more casualties than any other weapons except for artillery. They were capable of maintaining sustained fire for hours on end so long as simple precautions were observed, such as changing barrels regularly. Sited to cover vulnerable features, these guns usually operated in batteries, firing through fixed, interlocking arcs. When combined with barbed wire, they made it almost impossible for infantry to advance without taking enormous losses. Only with the development of effective armoured fighting vehicles (AFVs) was their omnipotence overcome.



▶ DWM MG08

Date	1908
Origin	Germany
Weight	26.5kg (58½lb)
Barrel	71.9cm (28¼in)
Calibre	7.92mm Mauser

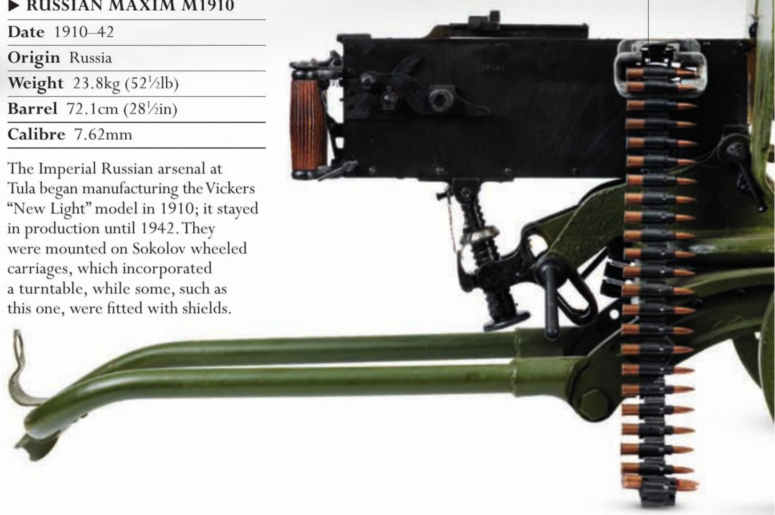
Soon after the German army acquired its first Maxims in 1895, Deutsche Waffen und Munitionsfabriken (DWM) began modifying the design, and the final version was adopted as the *schweres Maschinengewehr 08*. It had a heavy sledge-style mount, known as the *Schlitten*.


Rear sight
Cooling water in jacket reached boiling point after 600 rounds of rapid fire
Firing grip
Muzzle booster

▲ VICKERS-MAXIM "NEW LIGHT" MODEL 1906

Date	1906
Origin	UK
Weight	19.6kg (43¼lb)
Barrel	72.3cm (28½in)
Calibre	7.7mm

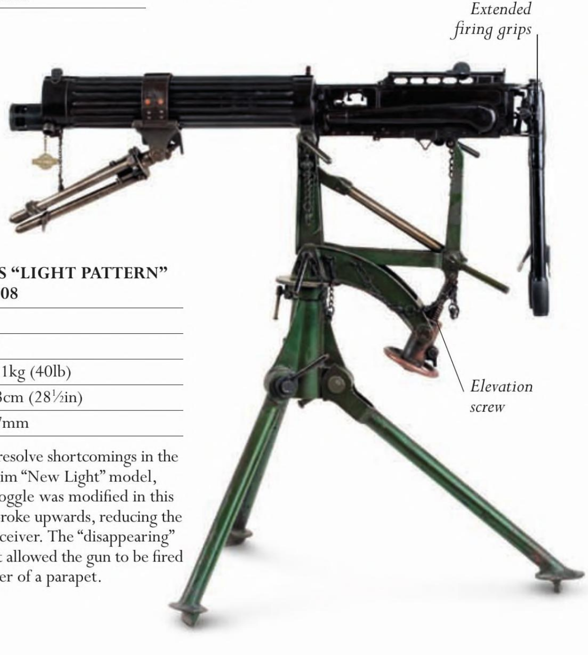
The first departure from Maxim's original design, the "New Light" saw the original brass fittings exchanged for much lighter steel, but continued to employ the downwards-breaking locking toggle that made the receiver large. The Russians adopted it as the M1910.



▶ RUSSIAN MAXIM M1910

Date	1910–42
Origin	Russia
Weight	23.8kg (52½lb)
Barrel	72.1cm (28½in)
Calibre	7.62mm

The Imperial Russian arsenal at Tula began manufacturing the Vickers "New Light" model in 1910; it stayed in production until 1942. They were mounted on Sokolov wheeled carriages, which incorporated a turntable, while some, such as this one, were fitted with shields.



▶ VICKERS "LIGHT PATTERN" MODEL 1908

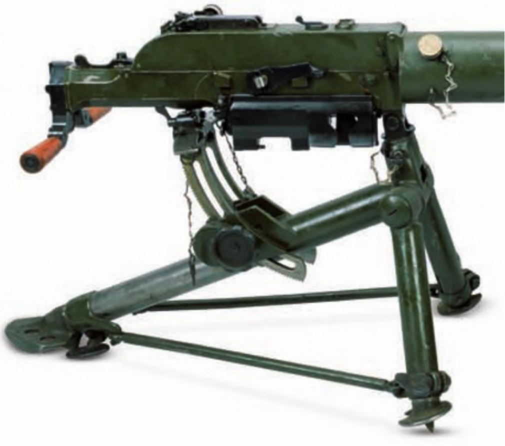
Date	1908
Origin	UK
Weight	18.1kg (40lb)
Barrel	72.3cm (28½in)
Calibre	7.7mm

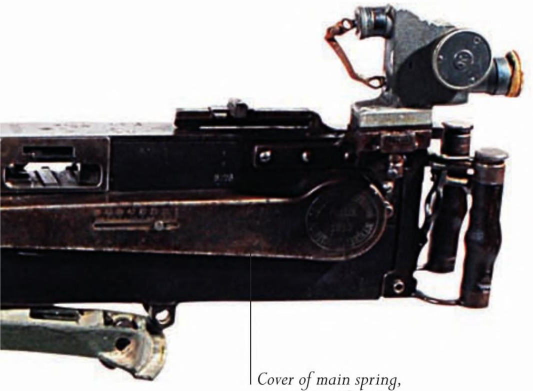
Designed to resolve shortcomings in the Vickers-Maxim "New Light" model, the locking toggle was modified in this gun: it now broke upwards, reducing the size of the receiver. The "disappearing" tripod mount allowed the gun to be fired from the cover of a parapet.

▶ SCHWARZLOSE M07/12

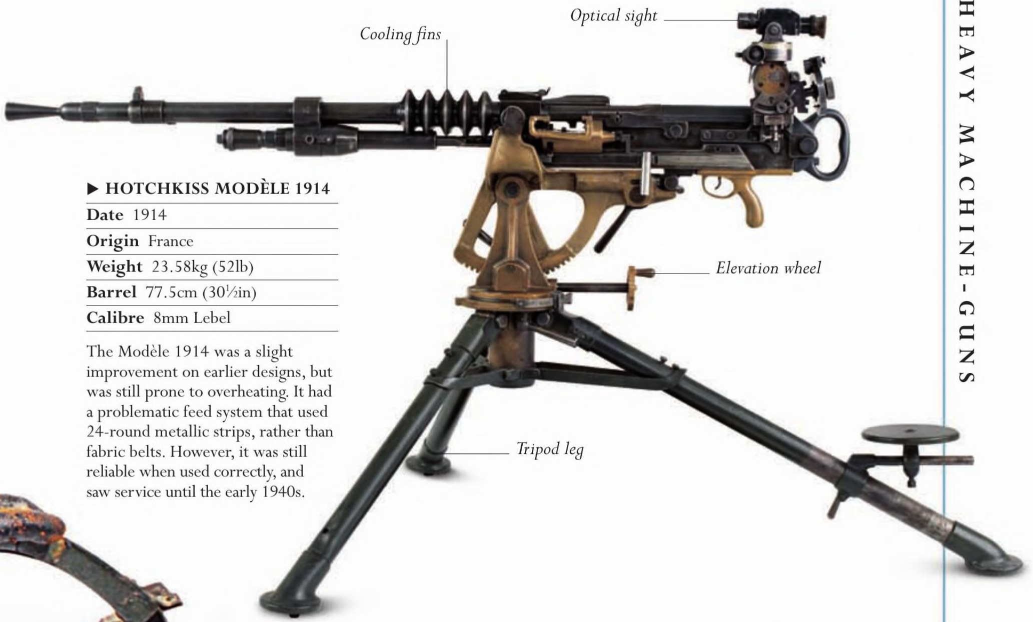
Date	1912
Origin	Austria-Hungary
Weight	19.9kg (43¾lb)
Barrel	52.6cm (20¾in)
Calibre	8mm Mannlicher

The Schwarzlose was the only heavy machine-gun to use an unlocked "blowback" system, better suited to pistol-calibre ammunition, relying on a very heavy breechblock and return spring to slow the rate of fire. Massively over-engineered, it proved almost indestructible in normal use.





Cover of main spring, known as a "fusee"

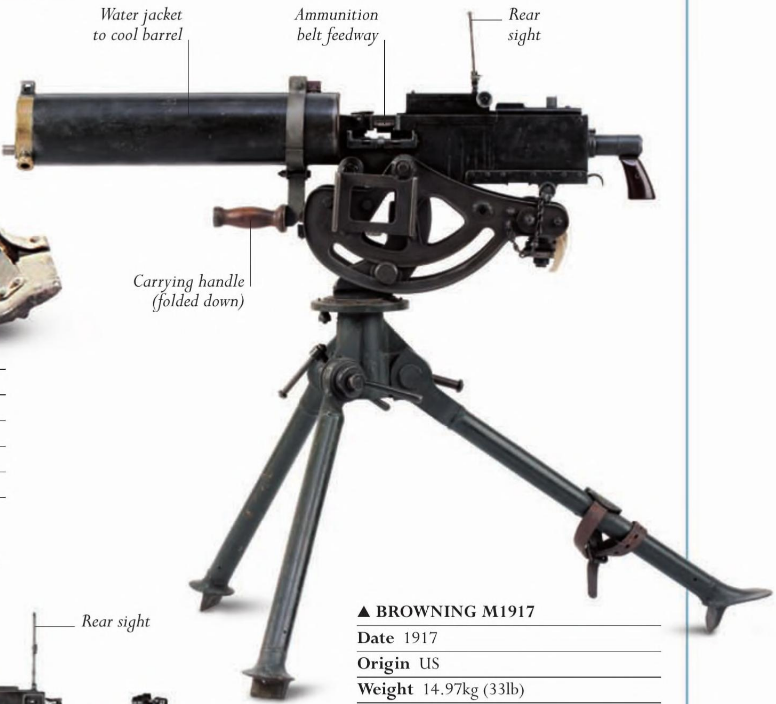


Cooling fins
Optical sight
Elevation wheel
Tripod leg

▶ HOTCHKISS MODÈLE 1914

Date	1914
Origin	France
Weight	23.58kg (52lb)
Barrel	77.5cm (30½in)
Calibre	8mm Lebel

The Modèle 1914 was a slight improvement on earlier designs, but was still prone to overheating. It had a problematic feed system that used 24-round metallic strips, rather than fabric belts. However, it was still reliable when used correctly, and saw service until the early 1940s.



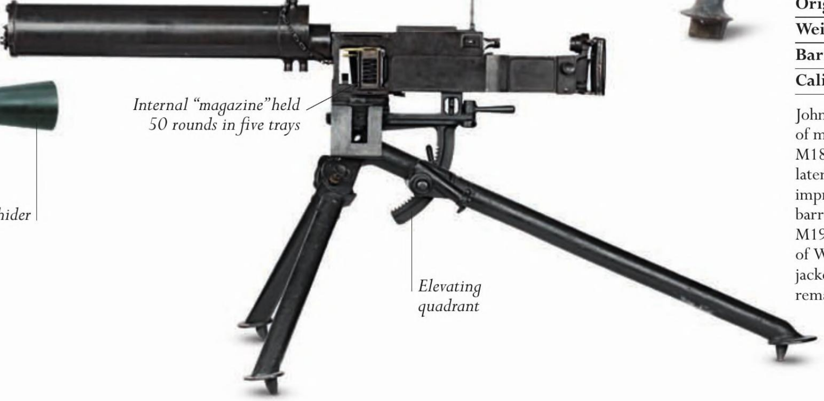
Water jacket to cool barrel
Ammunition belt feedway
Rear sight
Carrying handle (folded down)

Enlarged cap allowed water jacket to be filled with snow

▼ FIAT-REVELLI MODEL 1914

Date	1914
Origin	Italy
Weight	17kg (37½lb)
Barrel	65.4cm (25¾in)
Calibre	6.5mm Mannlicher-Carcano

This model employed a delayed "blowback" system to fire underpowered rounds, fed from a 50-round stack magazine and oiled on their way to the chamber. The oiled rounds picked up dust and dirt, causing the gun to jam regularly.



Rear sight
Internal "magazine" held 50 rounds in five trays
Elevating quadrant

Flash hider

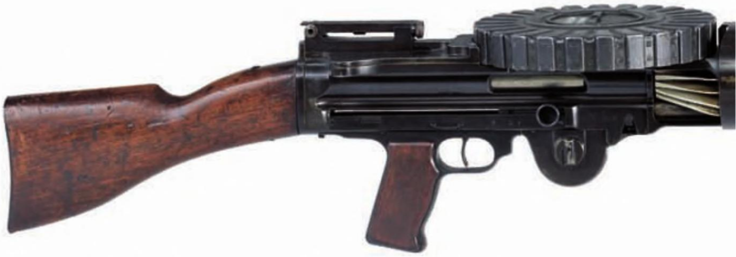
▲ BROWNING M1917

Date	1917
Origin	US
Weight	14.97kg (33lb)
Barrel	61cm (24in)
Calibre	.3in

John Browning produced a poor design of machine-gun for Colt, the gas-operated M1895 "Potato Digger" (see p.245), but later reverted to recoil actuation and improved on Maxim's method of locking barrel and breech together to create the M1917. It saw service in the latter months of World War I, but soon lost its water jacket to become the air-cooled M1919. It remained in use in that form until the 1960s.

LIGHT MACHINE-GUNS AND MACHINE-PISTOLS

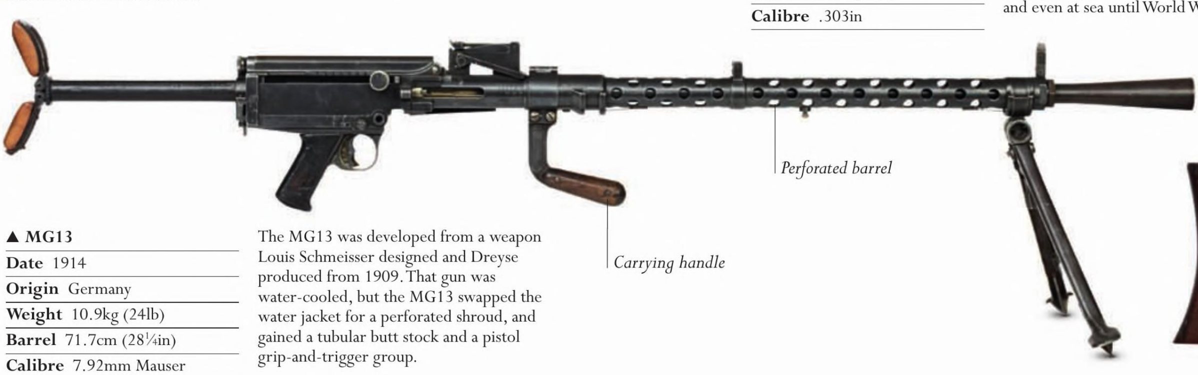
Although rapid-fire weapons ruled the battlefields of World War I, they were far too cumbersome to be carried into attack. The first step was to abandon ammunition belts, water-cooling, and the impossibly heavy static mount for magazines, and adopt lighter barrels and the sort of "furniture" found on rifles. These innovations led to the light machine-gun (LMG), which was handy enough, just about, for a man to fire from the hip on the move. The next stage in the development of automatic weapons was a complete departure. The machine-pistol was an entirely new form of a much lighter weapon, firing pistol-calibre ammunition in bursts.



▲ LEWIS GUN M1914

Date	1913
Origin	US
Weight	11.8kg (26lb)
Barrel	66cm (26in)
Calibre	.303in

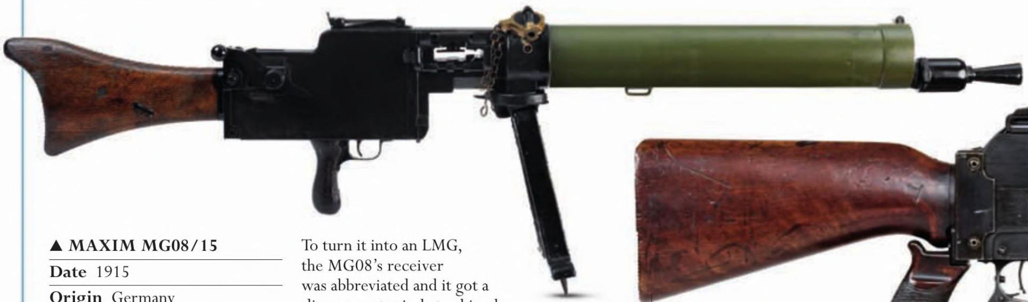
The air-cooled Lewis Gun was the first LMG used on the Western Front. Taken up by the Belgians, then by the British, it remained in service on the ground, in the air (when it was usually stripped of its barrel shroud), and even at sea until World War II.



▲ MG13

Date	1914
Origin	Germany
Weight	10.9kg (24lb)
Barrel	71.7cm (28¼in)
Calibre	7.92mm Mauser

The MG13 was developed from a weapon Louis Schmeisser designed and Dreyse produced from 1909. That gun was water-cooled, but the MG13 swapped the water jacket for a perforated shroud, and gained a tubular butt stock and a pistol grip-and-trigger group.

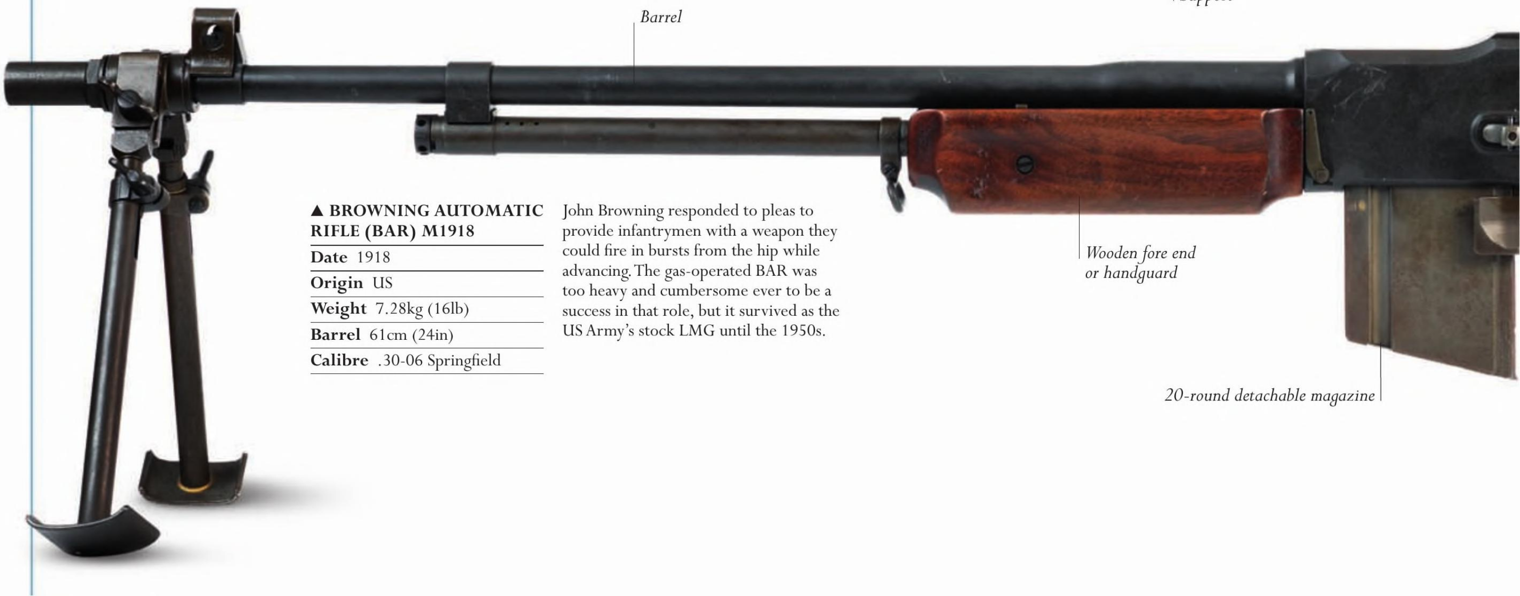


▲ MAXIM MG08/15

Date	1915
Origin	Germany
Weight	14kg (30¾lb)
Barrel	71.9cm (28½in)
Calibre	7.92mm Mauser

To turn it into an LMG, the MG08's receiver was abbreviated and it got a slimmer water jacket, a bipod, a butt, and a pistol grip and trigger. Ammunition belts were contained in drums.

Wooden butt
Trigger stabilizer
Support



▲ BROWNING AUTOMATIC RIFLE (BAR) M1918

Date	1918
Origin	US
Weight	7.28kg (16lb)
Barrel	61cm (24in)
Calibre	.30-06 Springfield

John Browning responded to pleas to provide infantrymen with a weapon they could fire in bursts from the hip while advancing. The gas-operated BAR was too heavy and cumbersome ever to be a success in that role, but it survived as the US Army's stock LMG until the 1950s.

Barrel shroud and heat dissipator
Bipod attachment clamp

▼ BERGMANN LMG15NA

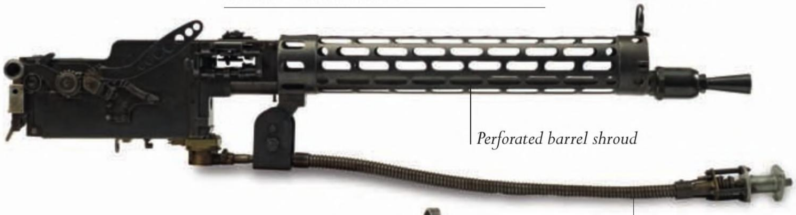
Date 1916
Origin Germany
Weight 12.9kg (28½lb)
Barrel 72.6cm (28½in)
Calibre 7.92mm Mauser

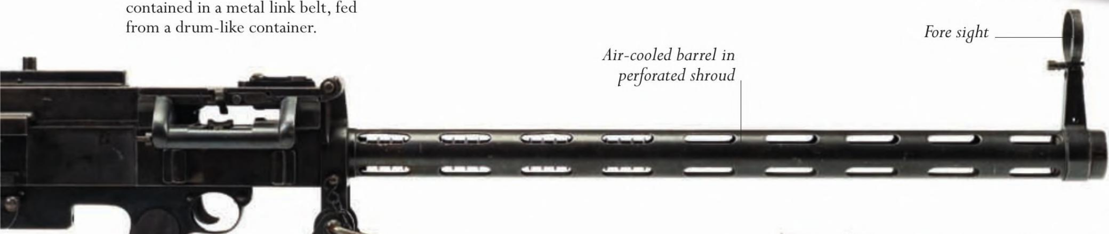
Bergmann's LMG was adopted in 1910, but it was not until the appearance of a modified version in 1916 that it found favour. Its ammunition was contained in a metal link belt, fed from a drum-like container.

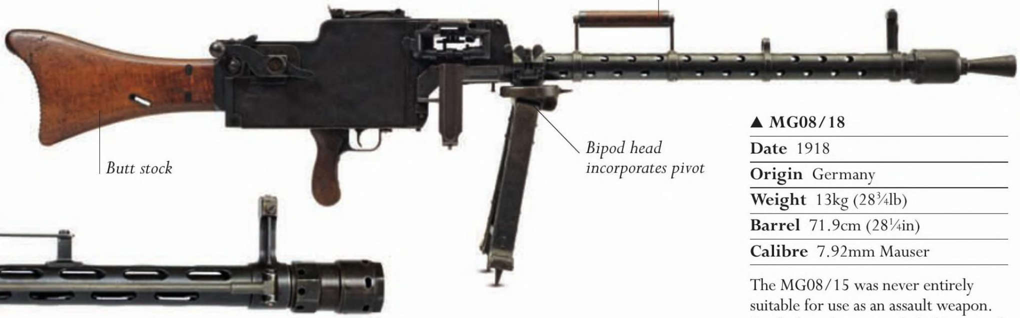
▼ DMW LMG08/15 (LUFTGEKÜHLT MASCHINENGEWEHR)

Date 1915
Origin Germany
Weight 12kg (26½lb)
Barrel 71.9cm (28¼in)
Calibre 7.92mm Mauser

Though it was also used by infantrymen, fitted with a buttstock and pistol grip, the LMG08/15 was developed as a fixed gun for use in aircraft. In this form, it had a synchronizer cable linked to an interrupter gear, which allowed it to fire through the propeller's arc.


Perforated barrel shroud
Synchronizer cable

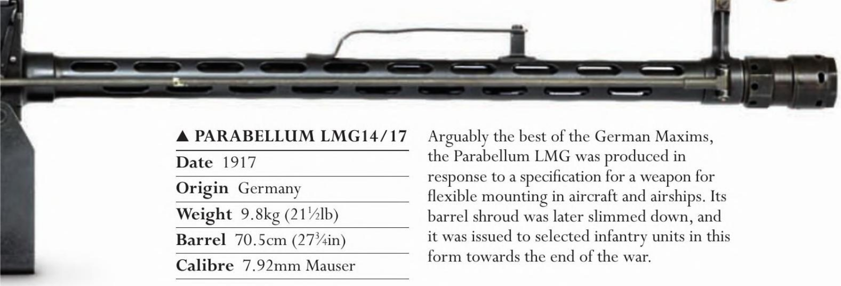

Fore sight
Air-cooled barrel in perforated shroud
Pistol grip


Carrying handle
Butt stock
Bipod head incorporates pivot

▲ MG08/18

Date 1918
Origin Germany
Weight 13kg (28¾lb)
Barrel 71.9cm (28¼in)
Calibre 7.92mm Mauser

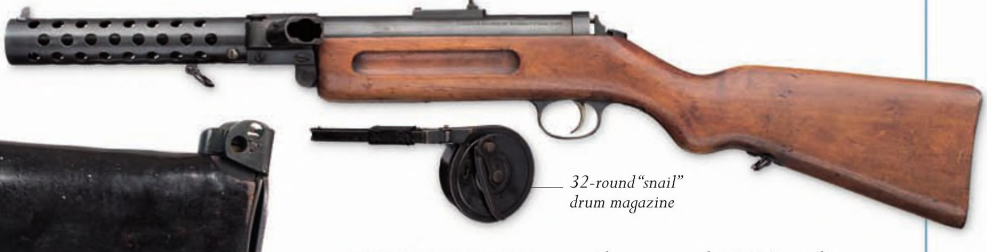
The MG08/15 was never entirely suitable for use as an assault weapon. Just before the war ended, this revised air-cooled version with a slimmed-down perforated barrel shroud was introduced. It was almost 4kg (8¾lb) lighter than the MG08/15, but came too late to see widespread use.



▲ PARABELLUM LMG14/17

Date 1917
Origin Germany
Weight 9.8kg (21½lb)
Barrel 70.5cm (27¾in)
Calibre 7.92mm Mauser

Arguably the best of the German Maxims, the Parabellum LMG was produced in response to a specification for a weapon for flexible mounting in aircraft and airships. Its barrel shroud was later slimmed down, and it was issued to selected infantry units in this form towards the end of the war.


Graduated rear sight
32-round "snail" drum magazine

▲ BERGMANN MP18/1

Date 1918
Origin Germany
Weight 4.2kg (9¼lb)
Barrel 19.6cm (7¾in)
Calibre 9mm Parabellum

The strong, sturdy MP18/1 was the first effective machine-pistol. It was chambered for the Parabellum round Luger had developed for the P08 pistol, although that resulted in feed problems until a simpler box magazine was designed.

Cocking handle
Butt

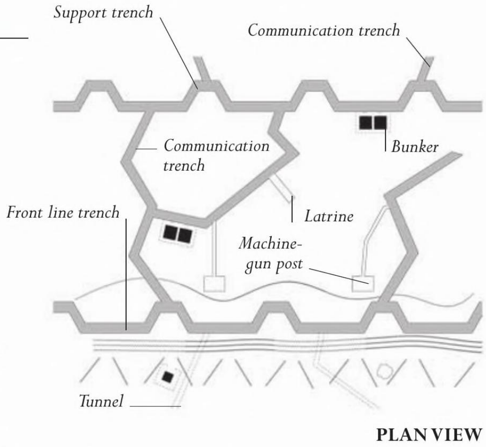
WORLD WAR I DEFENCES

BAYERNWALD TRENCH

For much of World War I, a line of trenches ran for 700km (435 miles) from the Belgian coast to the Franco-Swiss border west of Basel. Bayernwald was a German trench near Ypres, in Flanders.

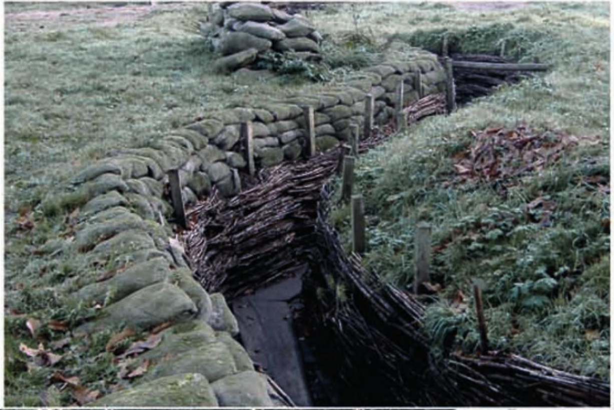
Following the "Race to the Sea" after the Battle of the Aisne, in September 1914, the opposing armies dug in to face each other. At first, the trenches they excavated were little more than ditches, but as the deadlock persisted trenches evolved into permanent fortifications incorporating bunkers and protected by belts of barbed wire. The "no-man's-land" between the opposing lines was sometimes as little as 25m (28 yards) wide, but was typically 10 times that.

The height of the trench walls was generally well over that of the soldiers, their sides "reveted" with timber, wattle, corrugated iron, and sandbags, and their bottoms lined with planks. Strongpoints were constructed using poured concrete or pre-fabricated blocks brought in at night. The nature of the trenches varied with the terrain, but in low-lying areas like Flanders they were always at risk of flooding, and daily life was a constant struggle against the mud. Since the Germans took up their positions first, they often had the advantage of choosing higher ground that was drier and less exposed to enemy fire.



▲ **SIMPLIFIED GERMAN TRENCH SYSTEM**
Reserve troops and supplies were moved from the support trench to the front via communication trenches, along which telephone lines also ran.

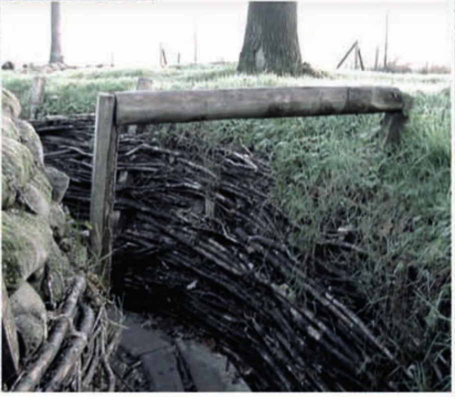
TRENCH STRUCTURE



► **FIRESTEP**
A simple wooden framework supported a step on which a man could stand to fire over the parapet. This was a risky business, so many soldiers equipped their rifles with a form of periscope.

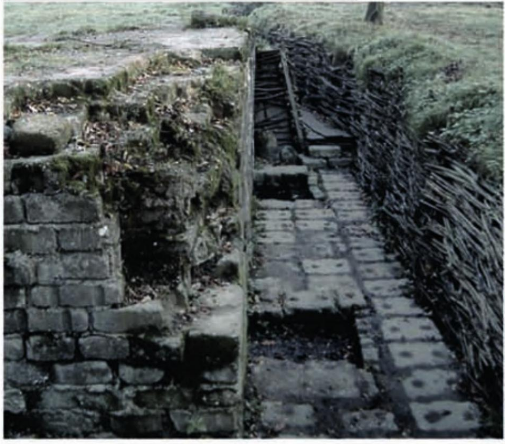
◄ **TRENCH LINE**
Trenches followed a meandering, zig-zag path. This gave some protection to the occupants against shrapnel and blasts from artillery rounds and grenades. It also prevented an enemy who had managed to break in from firing along the trench.

▲ **SHALLOW TRENCH**
Built in a raised location overlooking the enemy, the Bayernwald trench could be shallower than usual yet still protect troops from direct fire.



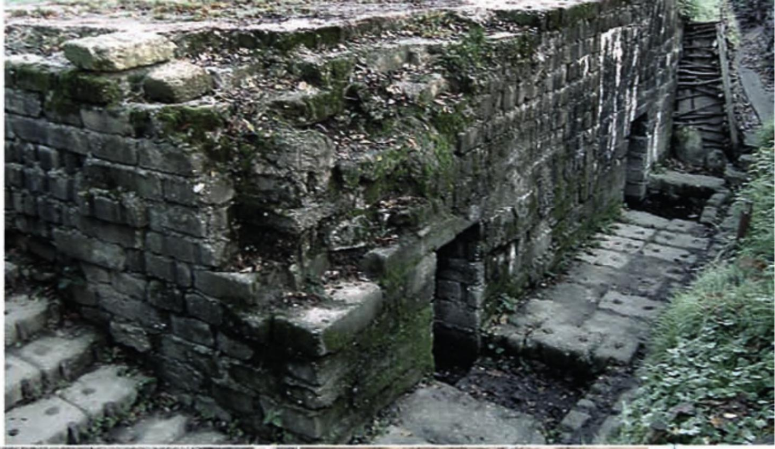
▲ **CROSS-TIMBER**
Trenches were bridged with timber beams; they supported roof sections, telephone lines, or hoses to pump out water.

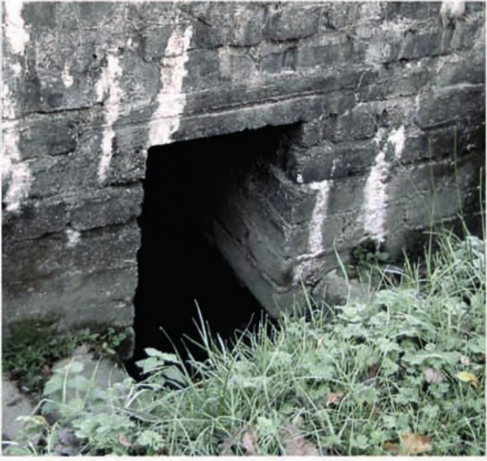
BUNKERS AND TUNNELS



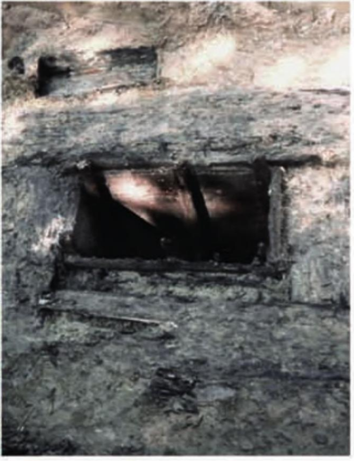
▲ **CONSTRUCTION**
The bunkers were built from pre-cast concrete blocks, carried in from a nearby narrow-gauge railway. Four bunkers and a protected mortar emplacement survive.

► **SHELTER**
There were 10 two-room bunkers on this site. They were not strong enough to withstand a direct hit from artillery, but did protect their occupants from shrapnel and small-arms fire.

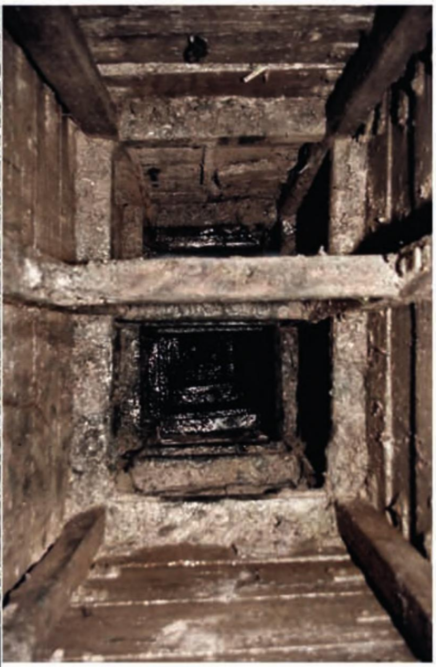




▲ **CONFINED SPACES**
Headroom within the bunkers was no more than 1.2m (4ft). In part, this was to ensure that troops sheltering inside would never get too comfortable.



▲ **TUNNEL ENTRANCE**
When conditions allowed, both sides tried to tunnel under the opposing lines, usually in order to explode mines.



▲ **ACCESS SHAFT**
Vertical shafts gave access to the tunnels. Fierce fighting broke out when opposing tunnellers broke in to each other's workings.

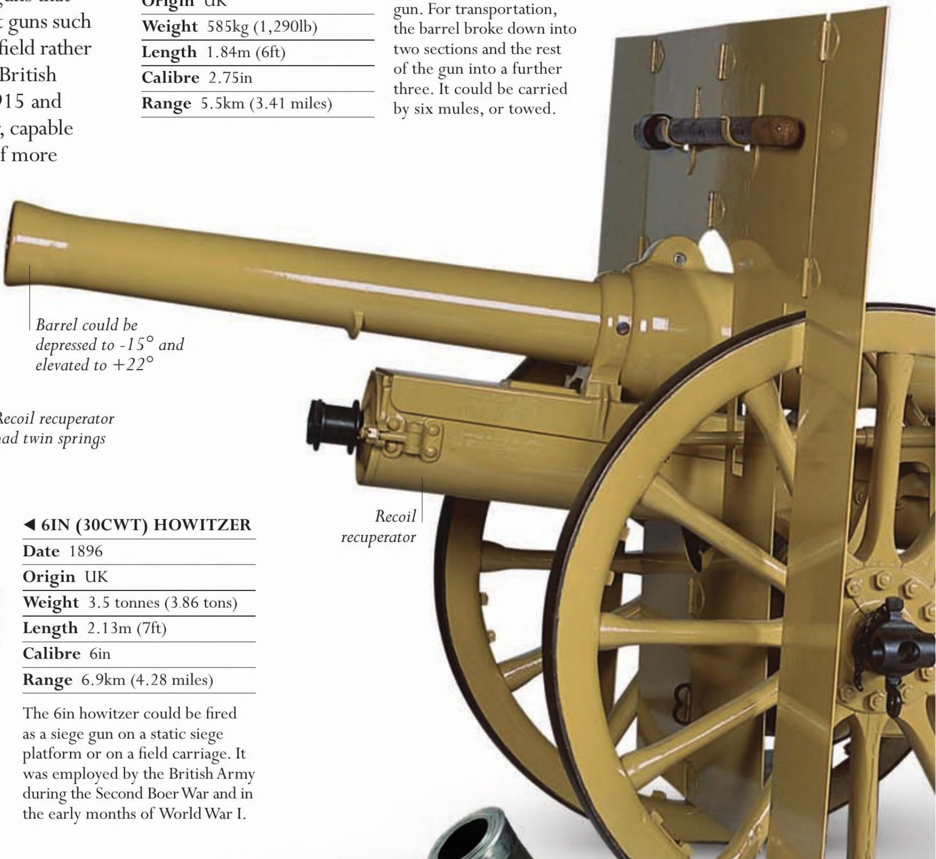
FIELD GUNS, SIEGE GUNS, AND HOWITZERS

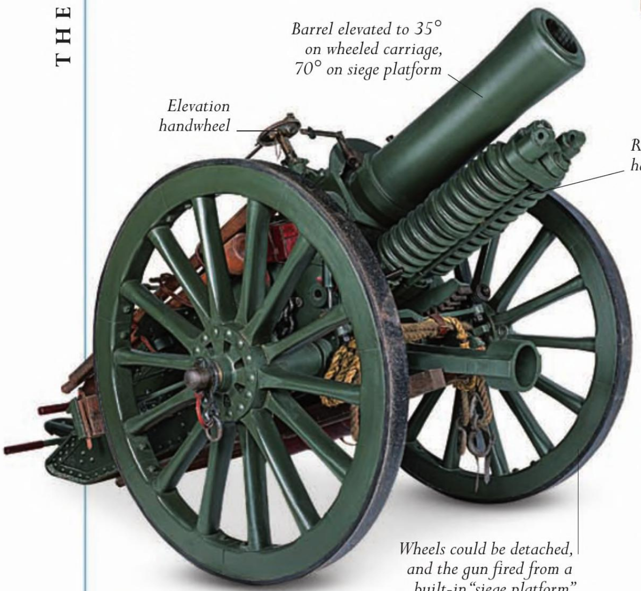
The artillery pieces in use by 1914 were capable of inflicting casualties on an industrial scale. They ranged from mountain guns that could be broken down quickly and carried by mules, and light guns such as the 18-pounder quick-firer – which were used on the battlefield rather than fired from a dug-in position – to howitzers such as the British Army's 9.2in Mark I. The latter arrived in France early in 1915 and became the most effective counter-battery weapon of the war, capable of hurling a 130kg (290lb) high-explosive shell to a distance of more than 9km (5½ miles). Guns mounted on railway tracks that could reach a target more than 40km (25 miles) away were used for long-range bombardment.

▼ 2.75IN MOUNTAIN GUN

Date 1911
Origin UK
Weight 585kg (1,290lb)
Length 1.84m (6ft)
Calibre 2.75in
Range 5.5km (3.41 miles)

This was an improved version of the tried-and-tested 10-pounder mountain gun. For transportation, the barrel broke down into two sections and the rest of the gun into a further three. It could be carried by six mules, or towed.

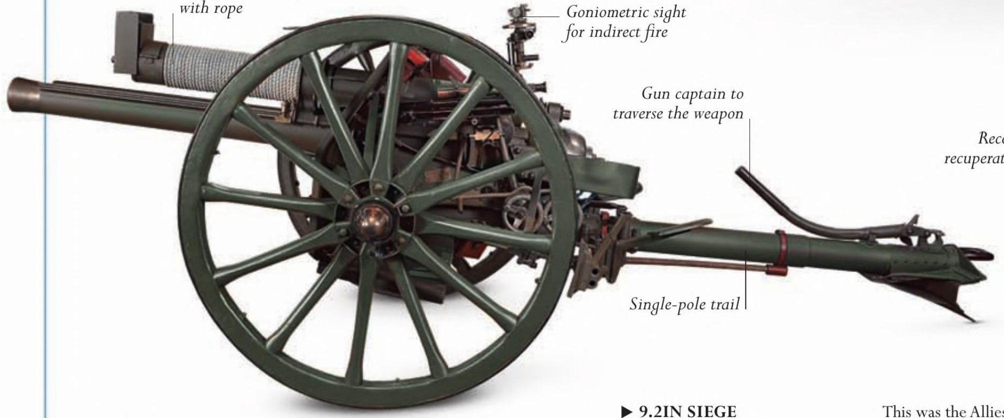

Barrel could be depressed to -15° and elevated to +22°
Recoil recuperator


Barrel elevated to 35° on wheeled carriage, 70° on siege platform
Elevation handwheel
Recoil recuperator had twin springs
Wheels could be detached, and the gun fired from a built-in "siege platform"

◀ 6IN (30CWT) HOWITZER

Date 1896
Origin UK
Weight 3.5 tonnes (3.86 tons)
Length 2.13m (7ft)
Calibre 6in
Range 6.9km (4.28 miles)

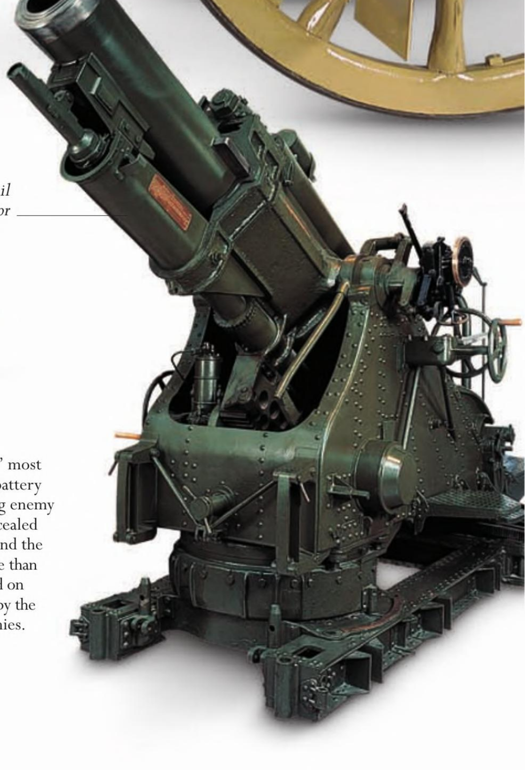
The 6in howitzer could be fired as a siege gun on a static siege platform or on a field carriage. It was employed by the British Army during the Second Boer War and in the early months of World War I.


Recuperator wrapped with rope
Goniometric sight for indirect fire
Gun captain to traverse the weapon
Single-pole trail

▲ 18-POUNDER QF MARK II

Date 1904
Origin UK
Weight 1.28 tonnes (1.41 tons)
Length 2.34m (7¾ft)
Calibre 3.3in
Range 6km (3.72 miles)

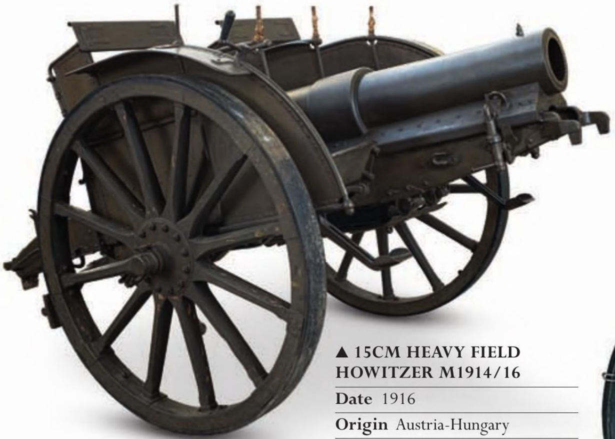
The standard British field gun for almost four decades, the 18-pounder was first introduced in 1904. It fired a wide variety of projectiles, including high explosive, shrapnel, gas, and armour-piercing rounds. Its six-man crew could fire 20 rounds per minute for short periods.


Recoil recuperator

▶ 9.2IN SIEGE HOWITZER MK I

Date 1914
Origin UK
Weight 12 tonnes (13.2 tons)
Length 3.4m (11ft)
Calibre 9.2in
Range 9.2km (5.71 miles)

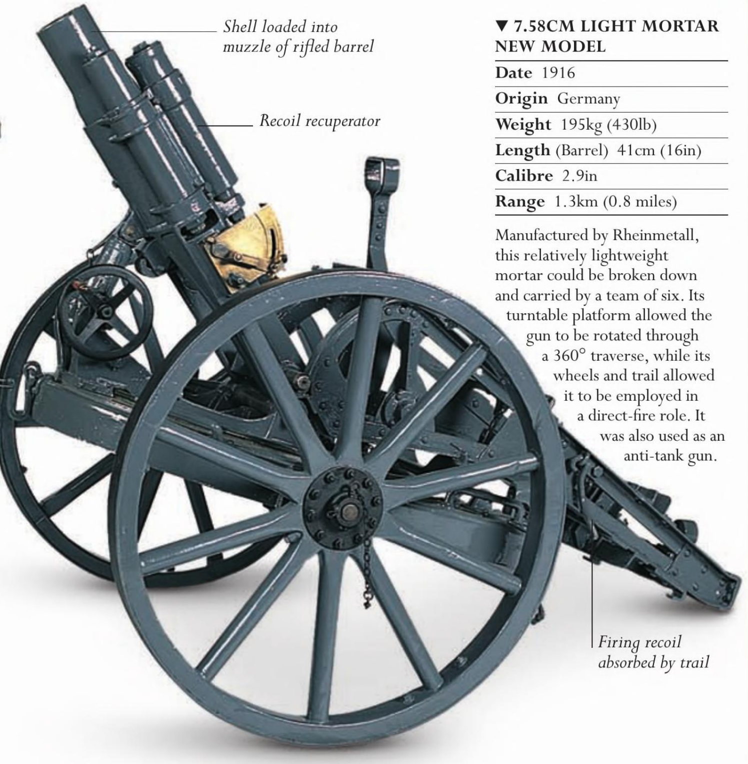
This was the Allies' most effective counter-battery weapon, destroying enemy artillery from concealed positions well behind the fighting front. More than 650 were employed on the Western Front by the British and US armies.



▲ 15CM HEAVY FIELD HOWITZER M1914/16

Date	1916
Origin	Austria-Hungary
Weight	2.77 tonnes (3.05 tons)
Length	2.12m (7ft)
Calibre	149mm
Range	8.75km (5.43 miles)

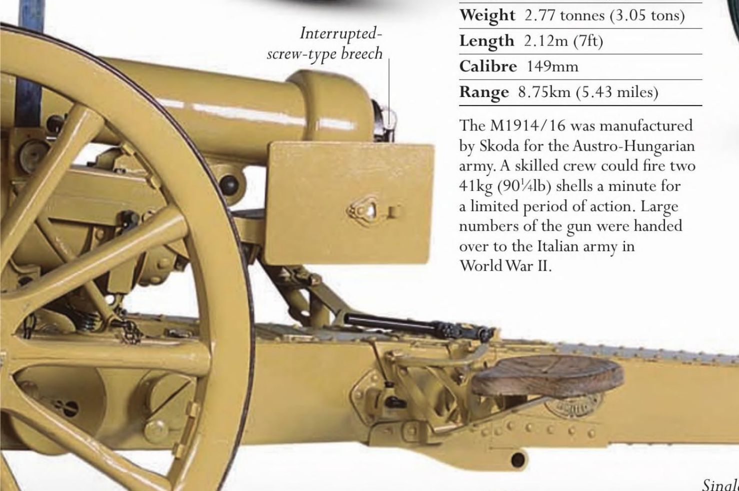
The M1914/16 was manufactured by Skoda for the Austro-Hungarian army. A skilled crew could fire two 41kg (90¼lb) shells a minute for a limited period of action. Large numbers of the gun were handed over to the Italian army in World War II.

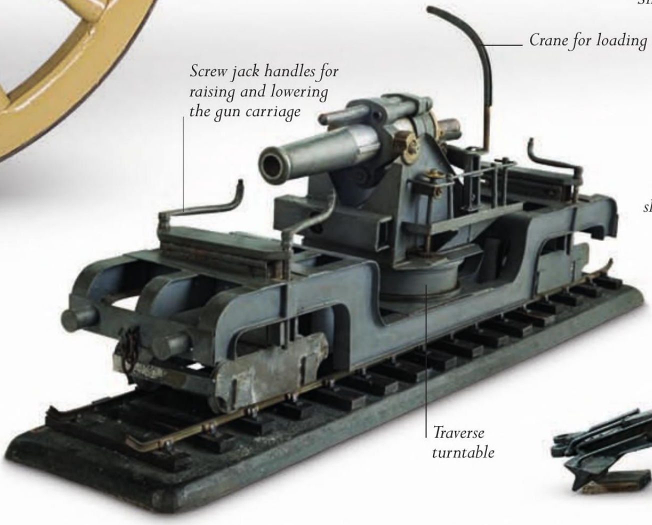

Shell loaded into muzzle of rifled barrel
Recoil recuperator
Firing recoil absorbed by trail

▼ 7.58CM LIGHT MORTAR NEW MODEL

Date	1916
Origin	Germany
Weight	195kg (430lb)
Length	(Barrel) 41cm (16in)
Calibre	2.9in
Range	1.3km (0.8 miles)

Manufactured by Rheinmetall, this relatively lightweight mortar could be broken down and carried by a team of six. Its turntable platform allowed the gun to be rotated through a 360° traverse, while its wheels and trail allowed it to be employed in a direct-fire role. It was also used as an anti-tank gun.

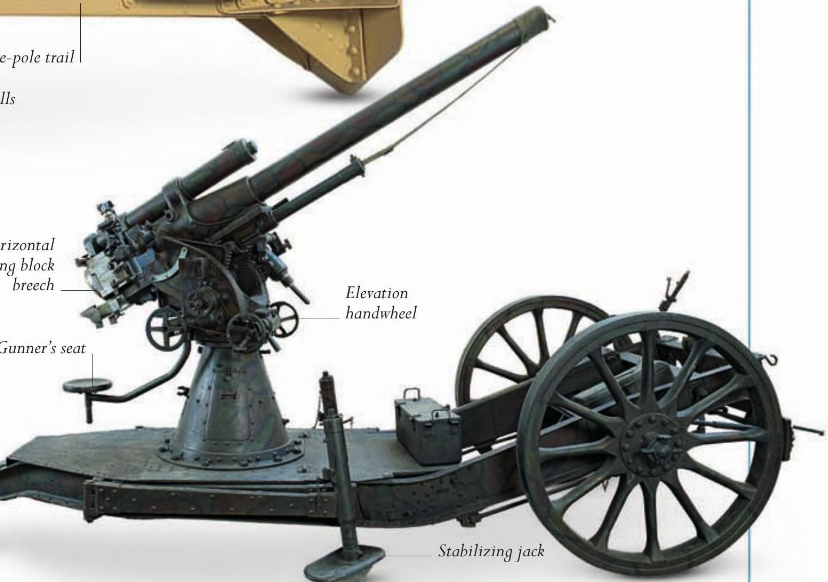

Interrupted-screw-type breech
Single-pole trail


Crane for loading shells
Screw jack handles for raising and lowering the gun carriage
Traverse turntable

▲ 12IN HOWITZER MARK I ON RAILWAY MOUNTING

Date	1916
Origin	UK
Weight	58.81 tonnes (64.81 tons)
Length	3.7m (12ft)
Calibre	12in
Range	10.17km (6.31 miles)

Manufactured by the Elswick Ordnance Company for the British Army, 12in railway howitzers were operated in pairs by British Royal Garrison Artillery. The short-barrelled Mark I was soon superseded by the longer-barrelled Mark III, which had 40 per cent greater range, and the Mark V, which had much-improved traverse.


Horizontal sliding block breech
Gunner's seat
Elevation handwheel
Stabilizing jack

▲ 7.7CM SOCKEL-FLAK

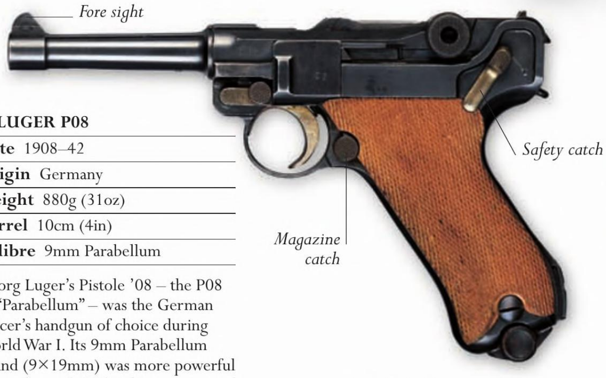
Date	1916
Origin	Germany
Weight	2.06 tonnes (2.27 tons)
Length	2.7m (8¾ft)
Calibre	77mm

The 7.7cm Sockel-flak was responsible for bringing down many of the 1,600 Allied aircraft that fell victim to anti-aircraft guns in World War I. It fired a 6.8kg (15lb) shell, which a skilled crew of six could fire at a rate of more than 20 rounds per minute. The effective ceiling of this gun was 4,750m (15,584ft).

TRENCH-FIGHTING WEAPONS

Throughout World War I, assaults on enemy positions almost inevitably ended in hand-to-hand combat in the confined spaces of trenches and dugouts. Pistols came into their own in such circumstances, but were issued mainly to officers. Individual soldiers armed themselves with the rifle-and-bayonet as well as expedient weapons such as knives and axes, which were chosen for their ability to disable or kill at a single stroke. The design of early grenades, though not entirely satisfactory, soon improved dramatically.

Semi-pistol stock
Lanyard ring


Fore sight
Safety catch
Magazine catch

▶ LUGER P08

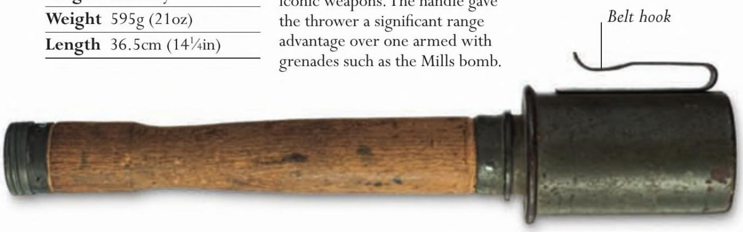
Date	1908–42
Origin	Germany
Weight	880g (31oz)
Barrel	10cm (4in)
Calibre	9mm Parabellum

Georg Luger's Pistole '08 – the P08 or "Parabellum" – was the German officer's handgun of choice during World War I. Its 9mm Parabellum round (9×19mm) was more powerful than others of similar dimensions, and became a world standard.

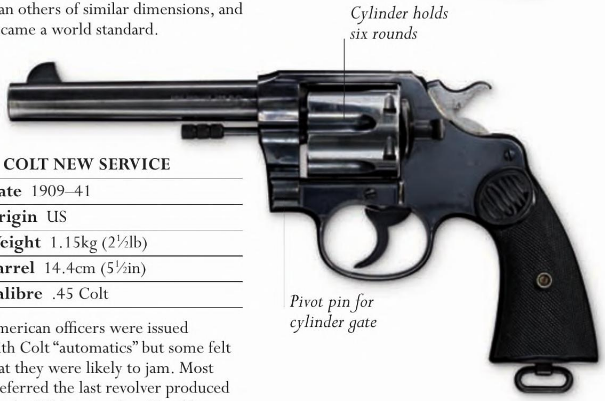
▼ STICK GRENADE

Date	1915
Origin	Germany
Weight	595g (21oz)
Length	36.5cm (14¼in)

The *Stielhandgranate* first saw service with German troops, and became one of the Stormtroopers' iconic weapons. The handle gave the thrower a significant range advantage over one armed with grenades such as the Mills bomb.



Serrated handle


Cylinder holds six rounds
Pivot pin for cylinder gate

▶ COLT NEW SERVICE

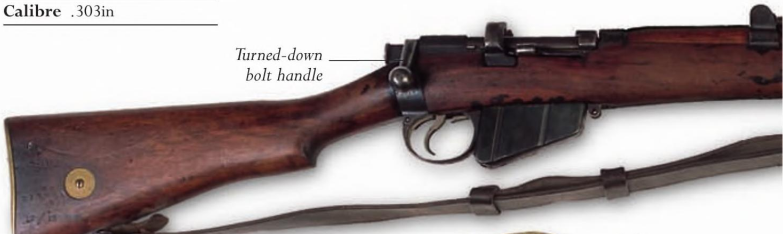
Date	1909–41
Origin	US
Weight	1.15kg (2½lb)
Barrel	14.4cm (5⅔in)
Calibre	.45 Colt

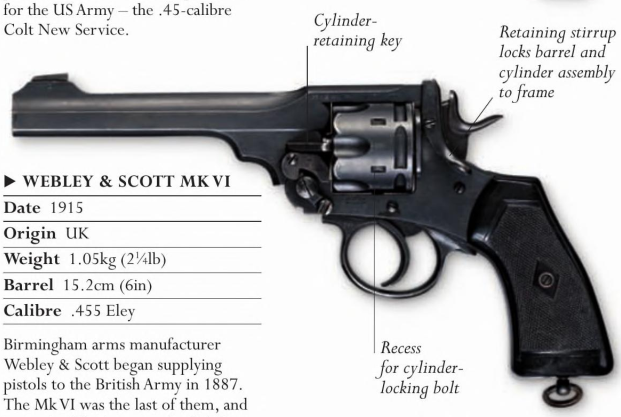
American officers were issued with Colt "automatics" but some felt that they were likely to jam. Most preferred the last revolver produced for the US Army – the .45-calibre Colt New Service.

▼ SMLE MKIII RIFLE WITH WIRE-CUTTING ATTACHMENT

Date	1907
Origin	UK
Weight	3.7kg (8lb)
Barrel	64cm (25in)
Calibre	.303in

The battlefields of World War I were festooned with barbed-wire entanglements, and many methods for dealing with this were tested. One involved fitting sprung cutting jaws to the muzzle of an SMLE rifle, but this proved ineffective.

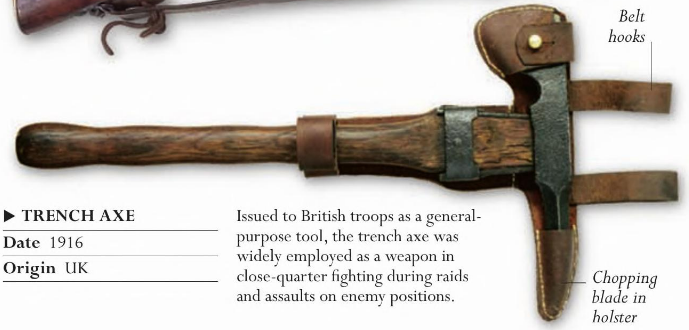

Turned-down bolt handle


Cylinder-retaining key
Retaining stirrup locks barrel and cylinder assembly to frame
Recess for cylinder-locking bolt

▶ WEBLEY & SCOTT MK VI

Date	1915
Origin	UK
Weight	1.05kg (2¼lb)
Barrel	15.2cm (6in)
Calibre	.455 Eley

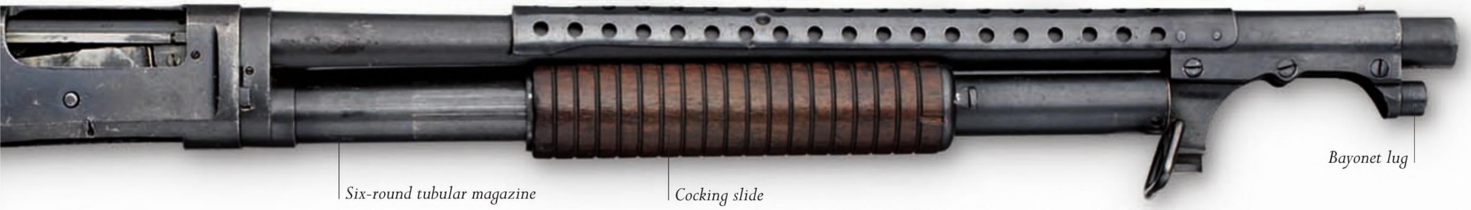
Birmingham arms manufacturer Webley & Scott began supplying pistols to the British Army in 1887. The Mk VI was the last of them, and was prized for its rugged reliability.


Belt hooks
Chopping blade in holster

▶ TRENCH AXE

Date	1916
Origin	UK

Issued to British troops as a general-purpose tool, the trench axe was widely employed as a weapon in close-quarter fighting during raids and assaults on enemy positions.


Bayonet lug
Six-round tubular magazine
Cocking slide

▲ WINCHESTER TRENCH GUN

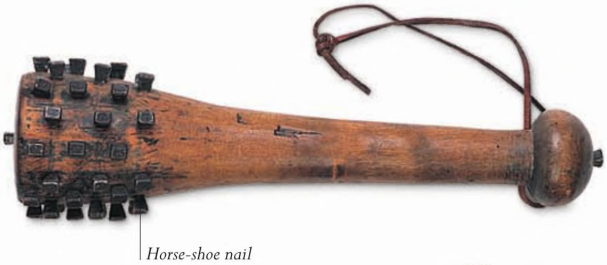
Date	1897
Origin	US
Weight	3.6kg (8lb)
Barrel	51cm (20in)
Calibre	12-bore

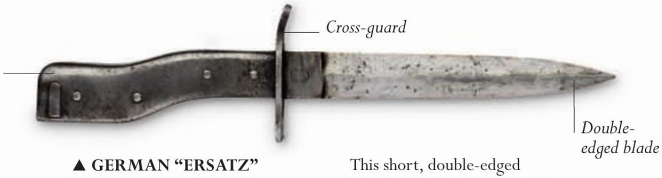
The Winchester Repeating Arms Company commissioned gun-designer John Moses Browning to develop a pump-action shotgun, and he produced the M1897. Its six-round magazine made it extremely useful to the combat infantryman.

▼ NAILED COSH

Date	1916
Origin	UK

The simplest trench-fighting weapons were clubs and truncheons, often – as in this example – with nails or spikes added to increase their lethality, and usually with a retaining loop.

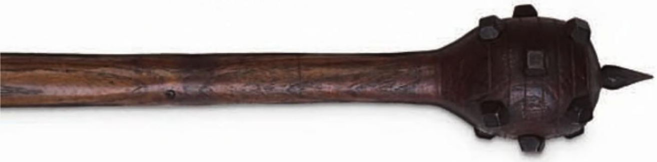

Horse-shoe nail


Cross-guard
Sheet-steel hilt
Double-edged blade

▲ GERMAN "ERSATZ" KNIFE BAYONET

Date	1917
Origin	Germany
Weight	220g (7¾oz)
Length	26.1cm (10¼in)

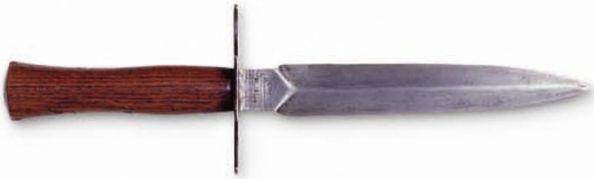
This short, double-edged bayonet, developed privately to fit the Mauser GeW'98 rifle, doubled as a combat knife, and many German soldiers bought one for themselves.



▲ BRITISH SPIKED CLUB

Date	c.1916
Origin	UK

This club, hand-whittled from hardwood, incorporates both horseshoe nails and a stabbing spike in its enlarged head. It also has serrations to improve the grip, and a wrist-strap for security.



▲ FRENCH TRENCH KNIFE

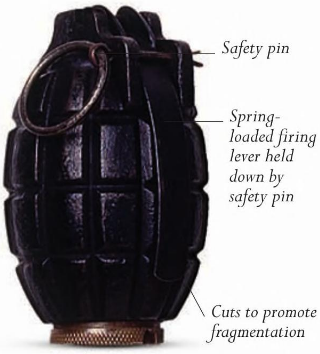
Date	1916
Origin	France

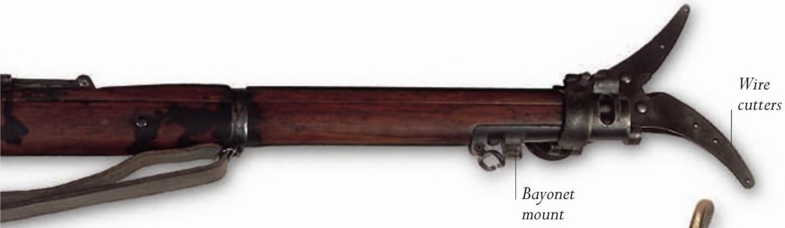
This was a simple stabbing and slashing weapon with a double-edged blade, a steel cross-guard, and an unadorned wooden grip, perhaps made at Laguiole in the Aveyron *département* of south-central France.

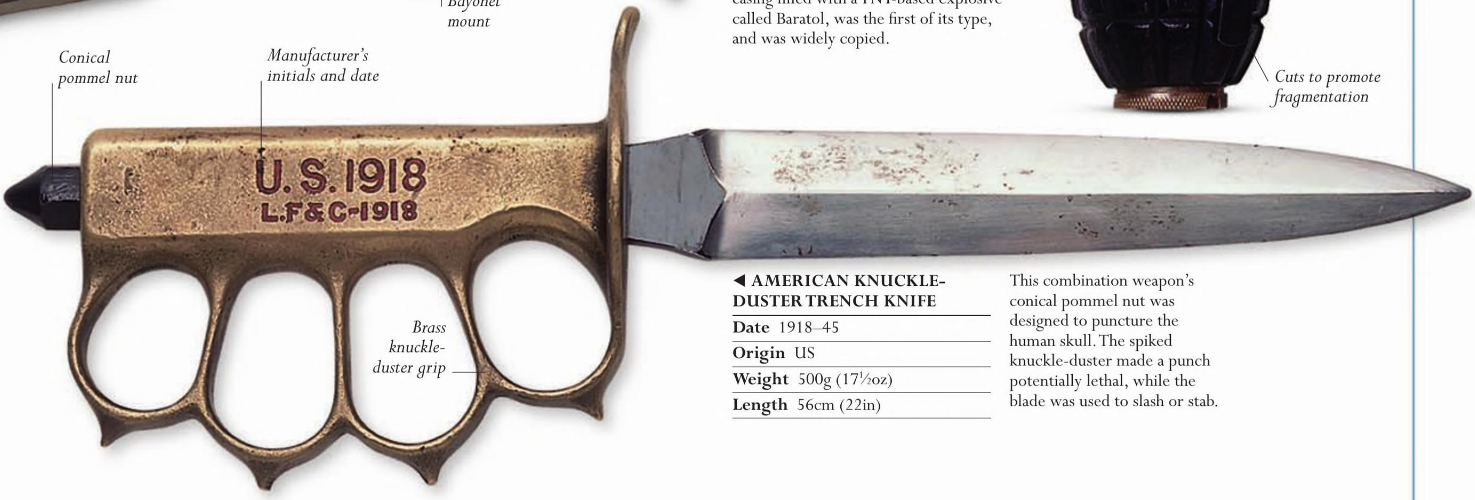
▶ NO. 36 MILLS BOMB

Date	1915
Origin	UK
Weight	765g (27oz)
Length	95.2mm (3¾in)

Grenades became more effective when reliable time-fuses became available. The British Mills Bomb, with its "pineapple" casing filled with a TNT-based explosive called Baratol, was the first of its type, and was widely copied.


Safety pin
Spring-loaded firing lever held down by safety pin
Cuts to promote fragmentation


Wire cutters
Bayonet mount


Conical pommel nut
Manufacturer's initials and date
U.S.1918
L.F.&C-1918
Brass knuckle-duster grip

◀ AMERICAN KNUCKLE-DUSTER TRENCH KNIFE

Date	1918–45
Origin	US
Weight	500g (17½oz)
Length	56cm (22in)

This combination weapon's conical pommel nut was designed to puncture the human skull. The spiked knuckle-duster made a punch potentially lethal, while the blade was used to slash or stab.

TRENCH WARFARE

THE BATTLE OF ARRAS

Caught in the stalemate of trench warfare, armies on the Western Front in World War I sought a fresh approach. In the Battle of Arras in April 1917, British and Commonwealth forces had initial success in infantry assaults on German lines, but fell short of the longed-for breakthrough.

British commanders at Arras were determined to avoid the disasters of the Somme offensive the previous year, when troops had plodded in lines toward machine-gun fire. Artillery and infantry planned to mount a skilful combined assault on the German positions, including the well-held Vimy Ridge. Before the operation, tunnels leading to the front were excavated to shelter the assembling troops. The longest of these tunnels was over a mile in length. Short trenches or "saps" stretched into the no-man's-land between the trench lines to provide advanced jumping-off points for the assault. Artillery observers, meanwhile, plotted the positions of German heavy guns, using sophisticated sound-ranging techniques and by spotting their muzzle flashes when they fired. This enabled British gunners to deliver accurate counter-battery fire, suppressing the German artillery when the attack began. Infantry and artillery officers also worked on coordinating a "creeping barrage" – a moving screen of exploding shells in front of advancing Allied troops.

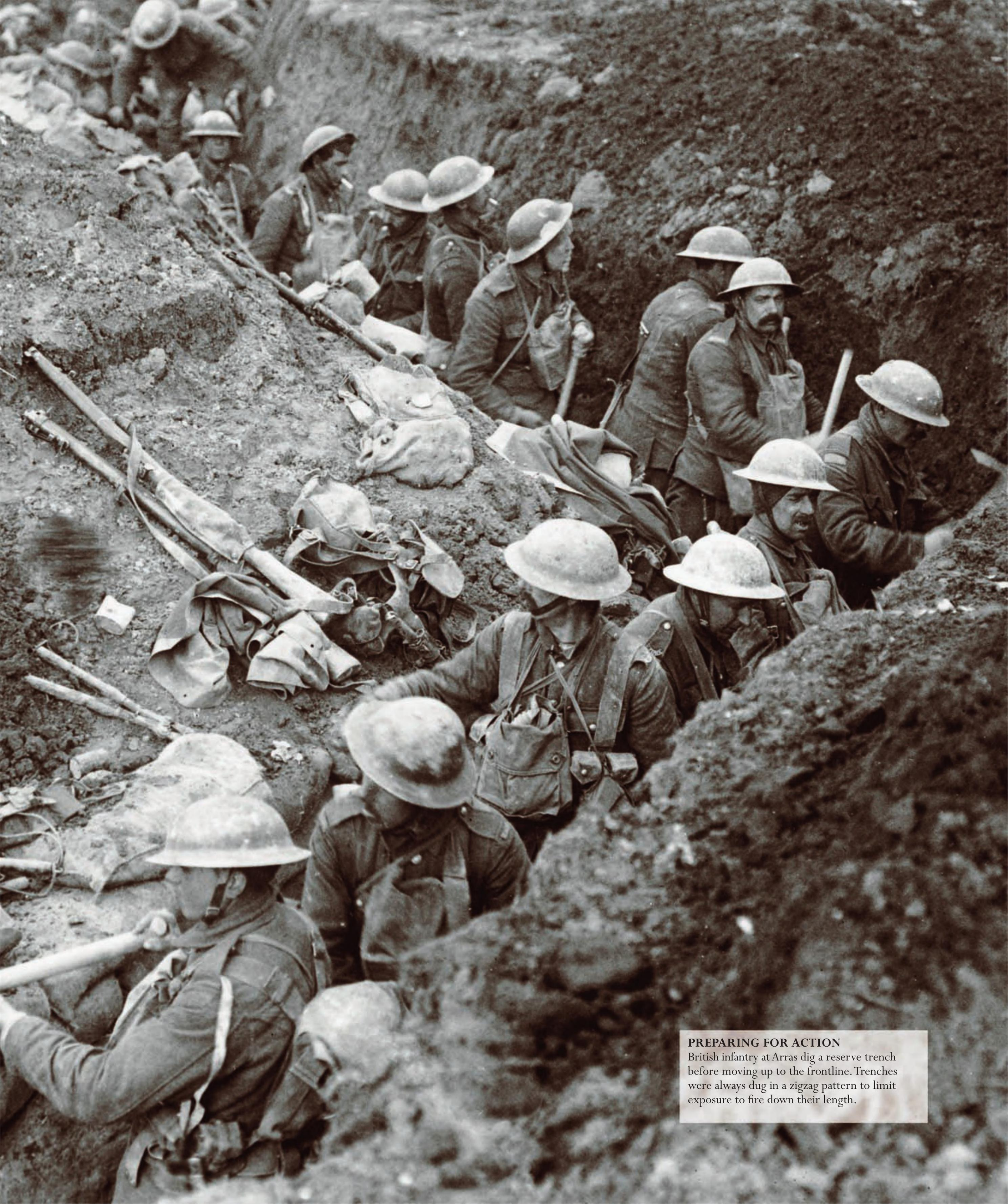
The offensive was preceded by a week-long bombardment of the German lines by more than 900 guns. This sacrificed any hope of surprise, but special fuses allowed shells to effectively break up the barbed wire in front of the German trenches – an essential preparation for the infantry advance. The attack was launched at 5:30am on Easter Monday, 9 April, with Canadian troops assigned to the sector in front of Vimy Ridge.

Soldiers moved forward, keeping some 46m (50 yards) behind the creeping artillery barrage. Other guns subdued the German batteries and fired poison gas shells into their defences. Massed British machine-guns meanwhile fired over advancing troops and onto German trenches, while dozens of tanks lumbered forward in support of the infantry.

The first wave of attackers reached the German frontline trenches in most places, at which point a fierce close-quarters struggle ensued with grenades and bayonets. A second wave of troops then passed through the first to continue the advance. British troops overcame German machine-gun nests using flexible small-unit tactics: one half of a platoon gave covering fire as their comrades dashed forward to attack. By the end of the first day's fighting, Vimy Ridge was in Canadian hands and other British troops had advanced about 5km (3 miles).

RETURN TO STALEMATE

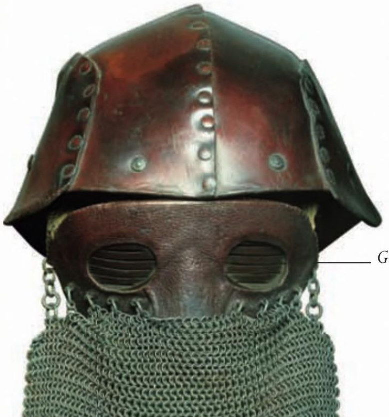
On 11 April British General Edmund Allenby claimed that his army was "pursuing a defeated enemy". Cavalry were sent forward in expectation of a breakthrough into open country, but this proved vastly overoptimistic. The artillery had performed impressively, but had also churned up the ground over which the advance had to proceed. While engineers prepared a path on which the British heavy guns could move forward, the Germans reinforced their defences. By 14 April, the advance had ground to a halt in the face of fresh German troops and uncut barbed wire. As was so often the case in World War I, doomed attempts to revive the offensive then went on for far too long, producing heavy casualties for little or no further gain.



PREPARING FOR ACTION
British infantry at Arras dig a reserve trench before moving up to the frontline. Trenches were always dug in a zigzag pattern to limit exposure to fire down their length.

TANKS AND ARMOURED VEHICLES

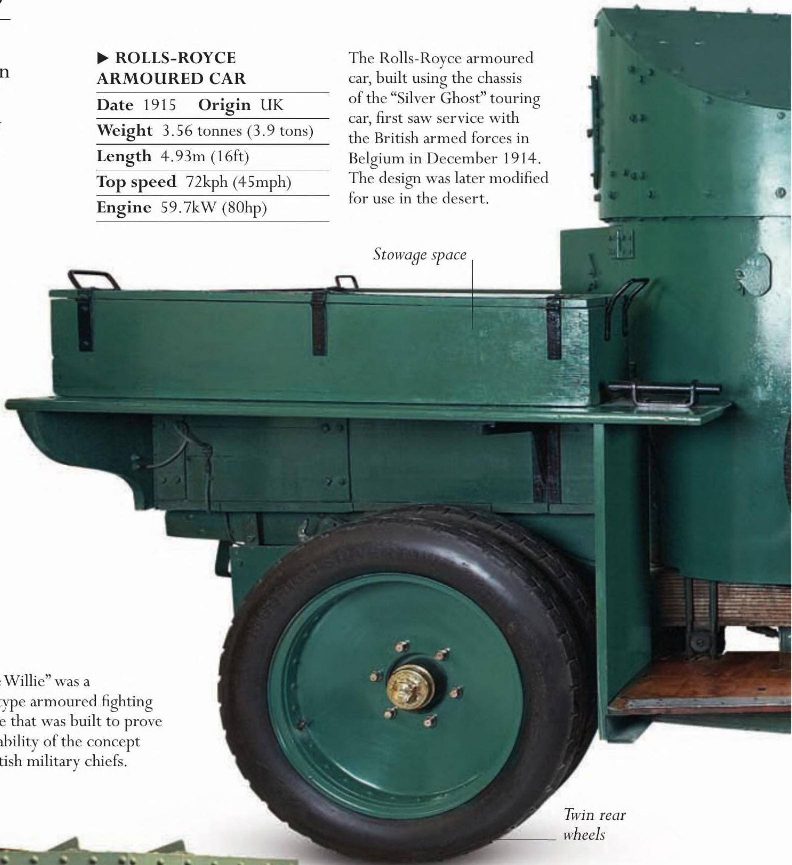
With the deadly combination of artillery, machine-guns, and barbed wire dominating the battlefield, the "poor bloody infantry" could not function effectively without some form of adequate protection in attack. The support offered by motor vehicles was limited due to their unreliability and difficulty in manoeuvring under all but ideal conditions. This led to the development of a form of armoured tractor that could run on continuous tracks rather than wheels, and had sufficient armour to be impervious to bullets and shrapnel. "Tanks", as they came to be called, were first deployed during the Battle of the Somme, in 1916, but it was not until the following year, at Cambrai, that they were first used with any real degree of success.


Goggles
Mail face mask

◀ TANK CREW HELMET

Date	1916
Origin	UK
Material	Steel, leather

Bullets striking the tank caused metal splinters to fly. British tankers were thus issued with these leather-covered steel helmets.


Stowage space
Twin rear wheels

▶ ROLLS-ROYCE ARMOURED CAR

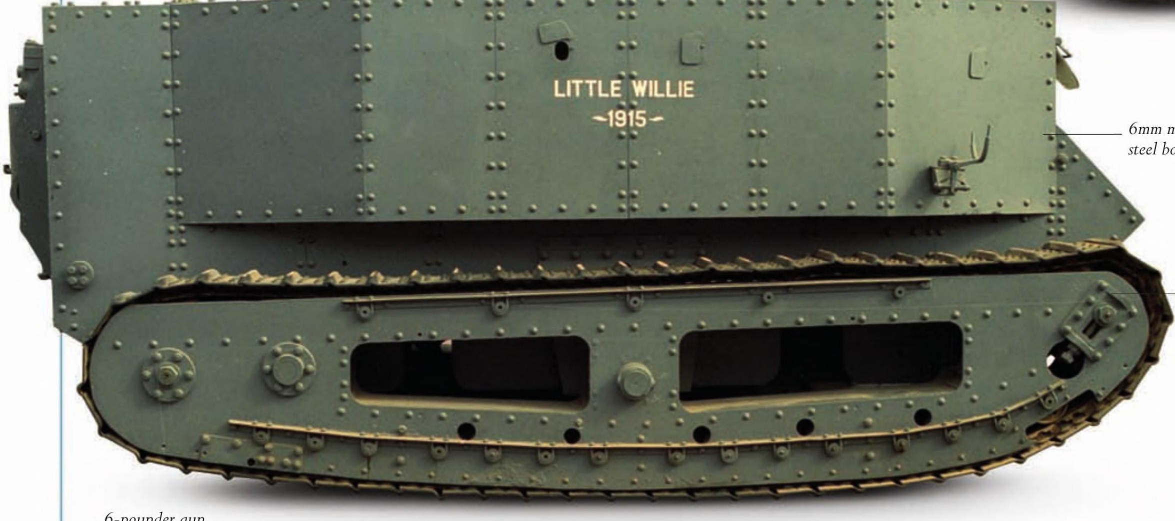
Date	1915 **Origin** UK
Weight	3.56 tonnes (3.9 tons)
Length	4.93m (16ft)
Top speed	72kph (45mph)
Engine	59.7kW (80hp)

The Rolls-Royce armoured car, built using the chassis of the "Silver Ghost" touring car, first saw service with the British armed forces in Belgium in December 1914. The design was later modified for use in the desert.

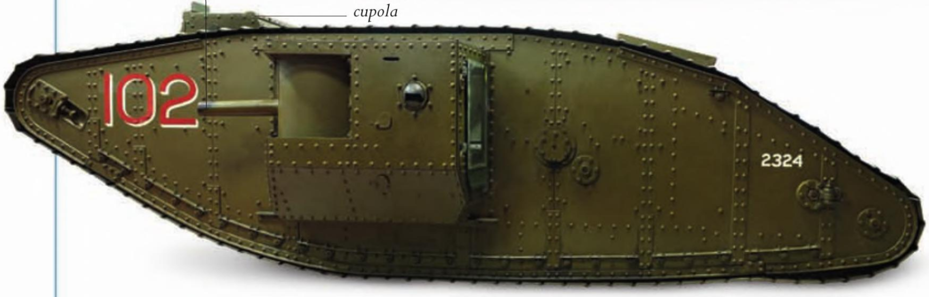
▼ "LITTLE WILLIE"

Date	1915 **Origin** UK
Weight	18.3 tonnes (20.2 tons)
Length	6.53m (21½ft)
Top speed	3kph (2mph)
Engine	78.3kW (105hp)

"Little Willie" was a prototype armoured fighting vehicle that was built to prove the viability of the concept to British military chiefs.


LITTLE WILLIE
-1915-
6mm mild steel bodywork
Track tensioner

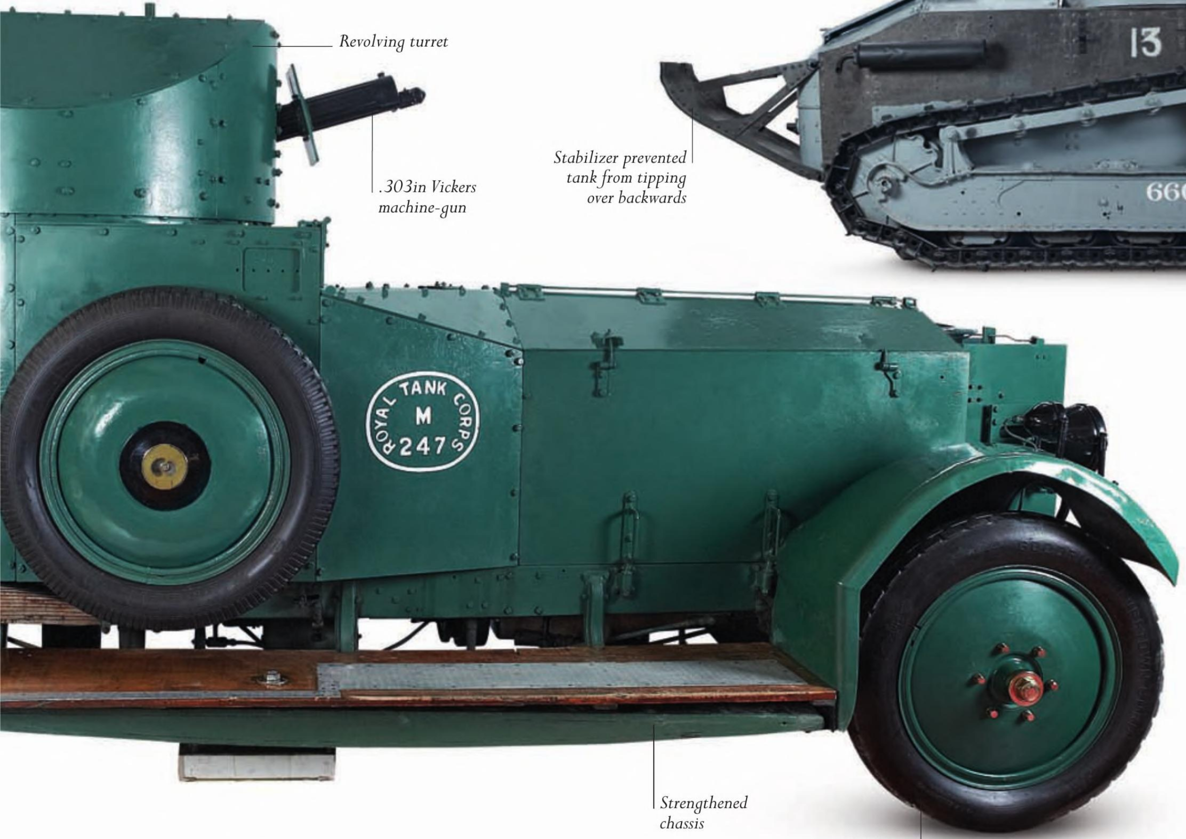
Hotchkiss machine-gun
A25
Continuous "caterpillar" track driven from the front


6-pounder gun
Command cupola
102
2324

◀ MARK IV TANK

Date	1917 **Origin** UK
Weight	28.4 tonnes (31.4 tons)
Length	8.02m (26¼ft)
Top speed	6kph (4mph)
Engine	78.3kW (105hp)

The improved Mark IV tank was built in large numbers. Crew safety was ensured by moving the petrol tank to the outside of the vehicle, a measure that also improved ventilation and comfort.

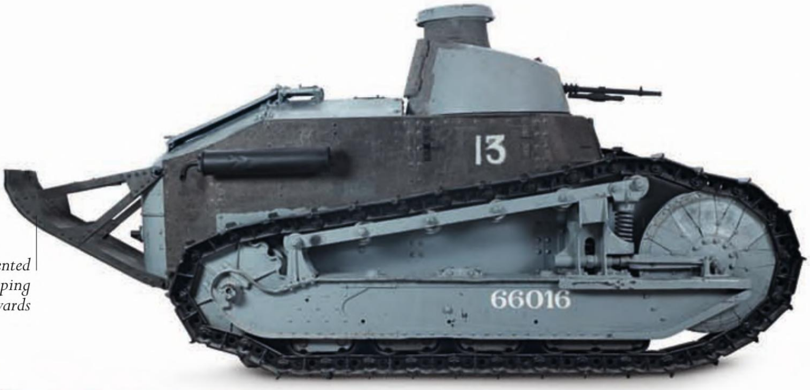


Revolving turret

.303in Vickers machine-gun

Strengthened chassis

Solid tyres



Stabilizer prevented tank from tipping over backwards

▲ RENAULT FT-17

Date 1917 **Origin** France

Weight 7 tonnes (7.7 tons)

Length 5.02m (16½ft)

Top speed 8kph (5mph)

Engine 26.1kW (35hp)

Also adopted by the US Army, the Renault FT-17 became the most widely used tank after World War I, and over 3,500 were built.

▼ A7V STURMPANZERWAGEN

Date 1918 **Origin** Germany

Weight 29.8 tonnes (33 tons)

Length 7.34m (24ft)

Top speed 13kph (8mph)

Engine Two 74.6kW (100hp)

The A7V tank, based on an American tracked tractor, came into service only in the last year of World War I, and just 30 were built. It had two Daimler-Benz petrol engines.

▼ MEDIUM MARK A WHIPPET

Date 1917 **Origin** UK

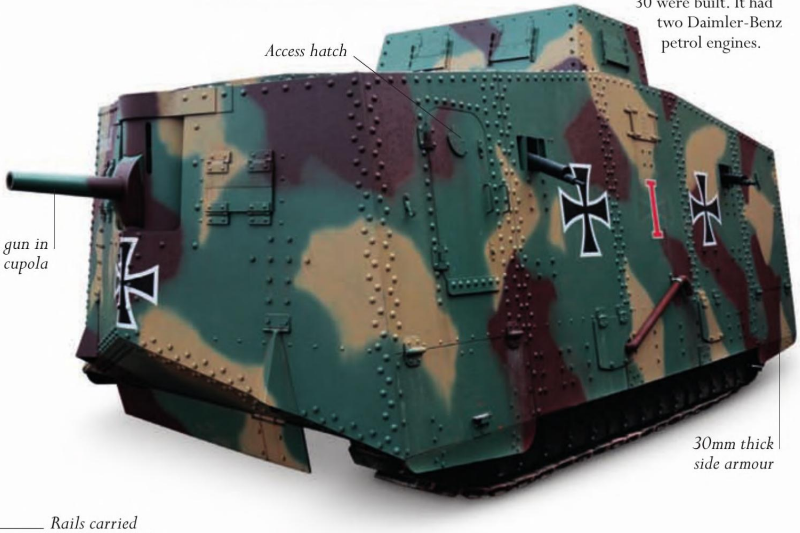
Weight 14.2 tonnes (15.6 tons)

Length 10.1m (33ft)

Top speed 12kph (7mph)

Engine Two 33.6kW (45hp)

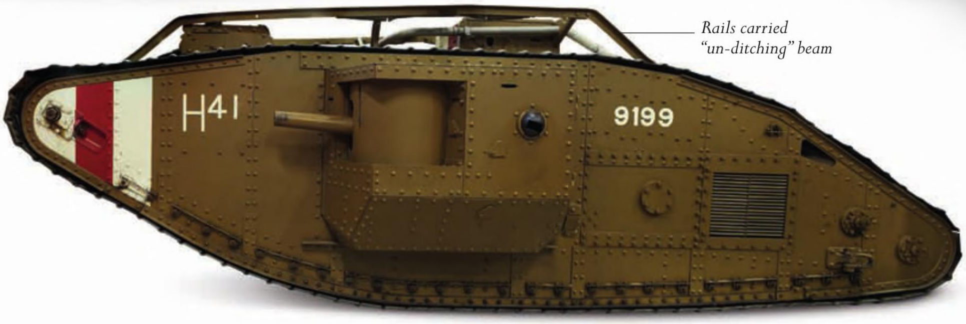
Developed as a scouting tank by cavalry units, the Whippet's tracks were each driven by a separate, 33.6kW (45hp), 6-cylinder petrol engine. The vehicle was turned by varying one engine's speed relative to the other. The fixed turret had three or four machine-guns.



Access hatch

5.7cm gun in rotating cupola

30mm thick side armour



Rails carried "un-ditching" beam

◀ MARK V TANK

Date 1918 **Origin** UK

Weight 29.5 tonnes (32.5 tons)

Length 8.05m (26½ft)

Top speed 8kph (5mph)

Engine 111.8kW (150hp)

The Mark V tank saw the introduction of epicyclic gearing, enabling the tank to be steered by one man instead of the four previously required. When chained to the tracks, its "un-ditching" beam was carried under the tank to free it when stuck in mud.

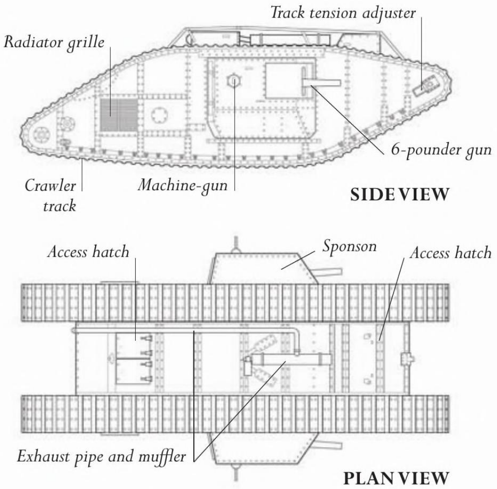
WORLD WAR I TANK

MARK V TANK

Tanks were first used by the British on the Somme in September 1916. Early models were unreliable, but showed strong fighting potential. Over 400 Mark Vs had entered service before the war's end.

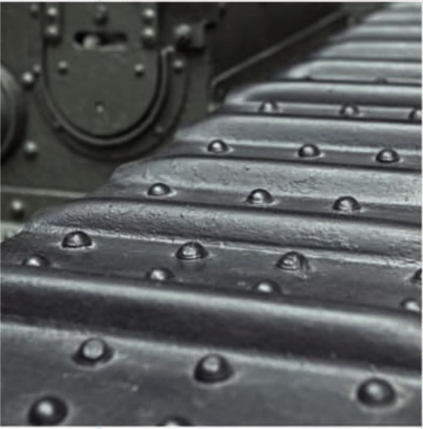
The Mark V, introduced in 1918, was the last of the lozenge-shaped British heavy tanks to fight on the Western Front. As with all of its predecessors, the Mark V's thick armour reduced both its speed and mobility. The tank was employed to lead infantry across no-man's-land, smashing a path through barbed wire and trenches.

Although resistant to machine-guns, heavy tanks were vulnerable to artillery fire, and when operated over muddy ground pitted with shell holes, they could also get stuck or break down. At the Battle of Cambrai in 1917, around 324 British heavy tanks carried out a mass attack on firm ground and demonstrated what the vehicle could achieve if properly used. Lighter, quicker tanks, such as the British Whippet and the French Renault FT-17 – which introduced the rotating gun turret – proved their worth in the relatively open combat of the war's later stages.

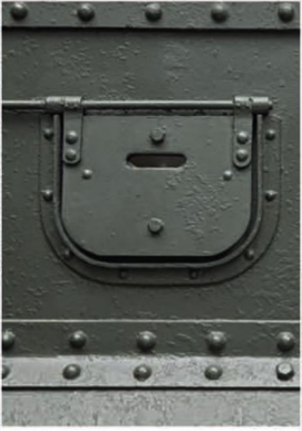


▲ MARK V TANK
The tank was 8.05m (26½ft) long and weighed 29.5 tonnes (29 tons). Its 112kW (150hp) Ricardo engine gave it a top speed of 7.4 kph (4½mph).

TANK EXTERIOR

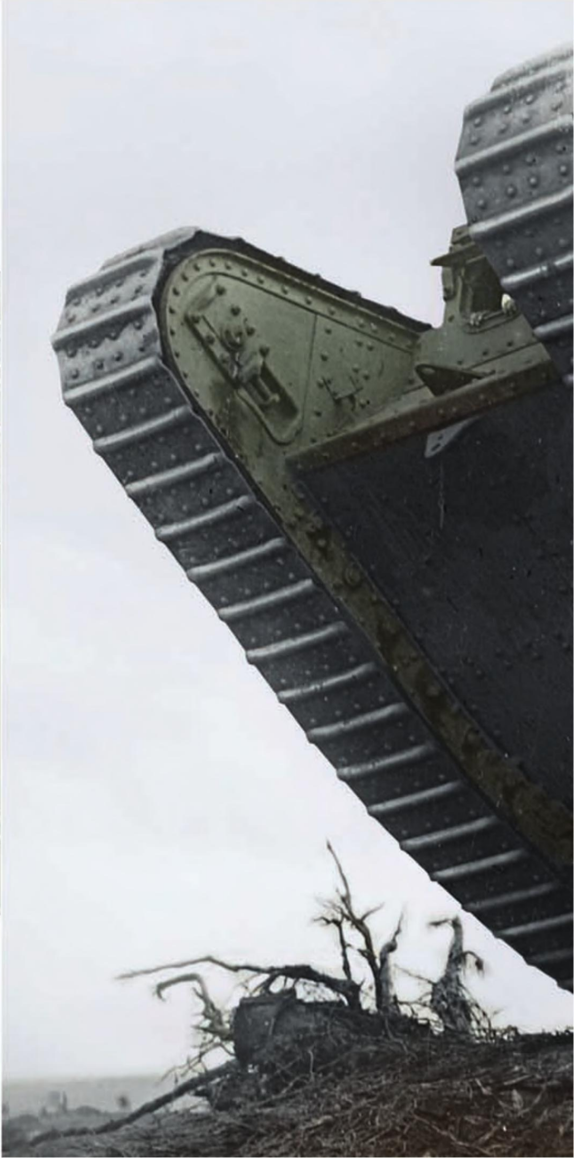


▲ CRAWLER TRACK
The tank moved on two tracks – loops of riveted metal links that ran around rollers.

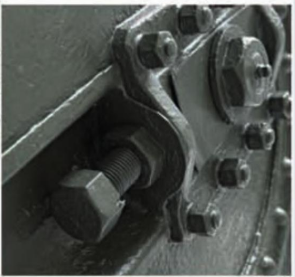


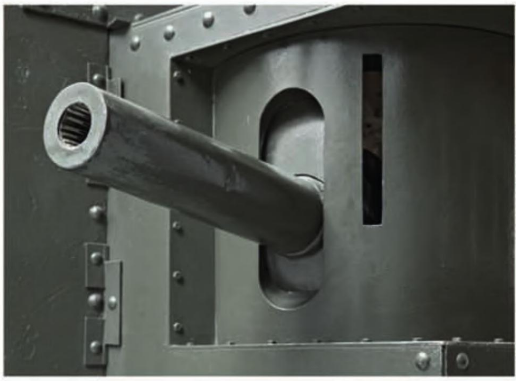
▲ FRONT VIEW
Enemy troops trained their fire on the vision ports, so tank crews began to wear face masks.

▶ "MALE" TANK
Versions with two 6-pounder guns and four Hotchkiss machine-guns were known as "male" tanks; "female" tanks were equipped only with machine-guns.

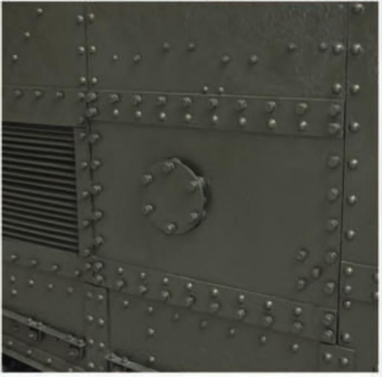


▼ ADJUSTER NUT
To give the correct traction, the tension in the tracks was altered by turning adjuster nuts.



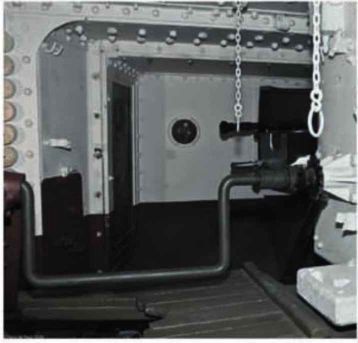


▲ 6-POUNDER GUN
Two crew manned each of the quick-firing 6-pounders, which were located on either side of the tank in armoured projections called sponsons. Each sponson also mounted a machine-gun.



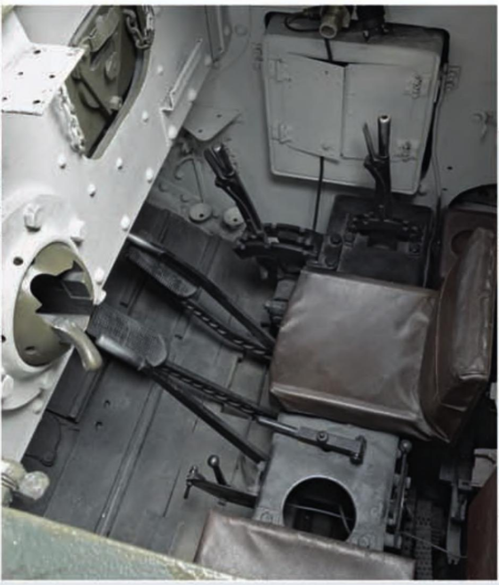
▲ ARMOUR
The Mark V was clad in riveted steel plates, up to 14mm (½in) thick, that could withstand German armour-piercing bullets. The engine radiator grille is visible on the left.

INSIDE THE TANK

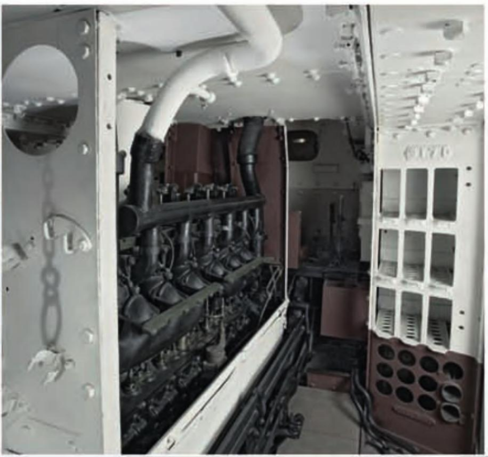


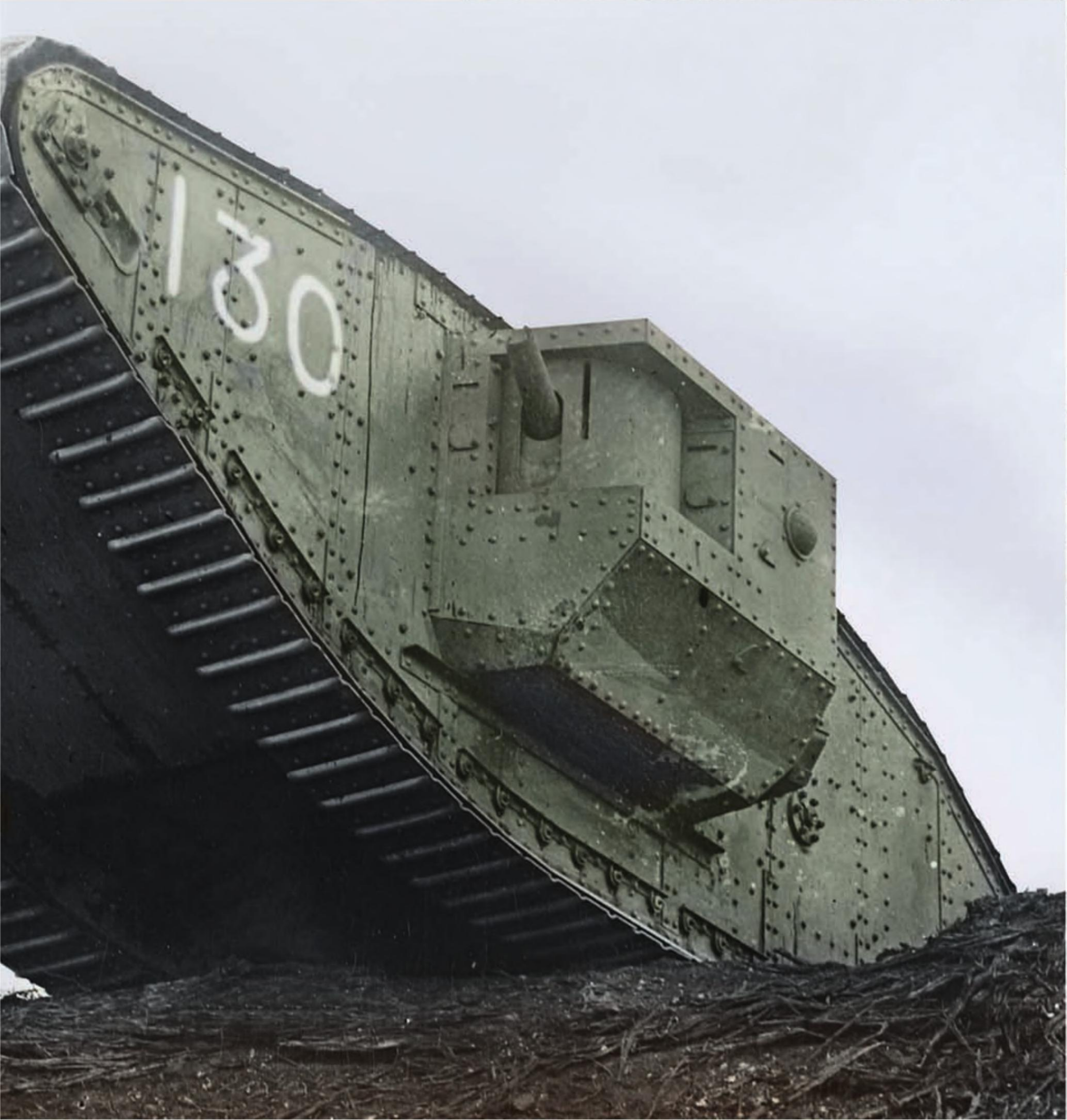
▲ STARTER CRANK
The water-cooled engine was started by four members of the crew turning a large crank handle.

▶ DRIVER'S SEAT
The driver sat to the commander's right. He had to bring the tank to a halt to turn it, which made it an easy target.



▼ INTERIOR CONDITIONS
The crew – commander, driver, and six gunners – worked in hot, cramped, noisy, fume-filled conditions. Bullets hitting the exterior sent steel splinters flying inside the tank, so the men wore protective clothing.





▲ UNCOVERED ENGINE
The engine was exposed so that it could be kept lubricated while running.

▲ SHELLS
A Mark V carried 207 high-explosive and case-shot rounds, stored on shelves beside the sponsons.

◀ HATCH LEVER
There were access hatches for the crew on the roof, on the sponsons, and also at the rear of the tank.

COMMUNICATIONS EQUIPMENT OF WORLD WAR I

As battlefields and armies grew in size, the need for effective long-distance communication became more urgent. Paper messages were carried by human couriers, as well as carrier pigeons and dogs, with varying degrees of reliability. Traditional signalling systems such as semaphore, flares, and heliographs were joined on the battlefield by new forms of telegraphy, based on electricity. Cable telegraphy, which depended on long wires connecting fragile telegraph machines, and wireless telegraphy, which demanded cumbersome hardware, were vulnerable to interception by the enemy. Notably, the entry of America into the conflict in 1917 was precipitated by the interception of a German telegram.

Flags were made from serge or silk – silk flags were quicker to manipulate

◀ SEMAPHORE FLAGS

Date 1914–1918

Origin UK

Type Signalling

The semaphore flag signalling system was developed for use as a way of communicating between ships in the 19th century, and remained in use until rendered obsolete by the introduction of lightweight radios. A practised signaller could signal a dozen or more words per minute.

Leather collar with secure pocket

◀ DOG COLLAR

Date 1914–1918

Origin UK

Type Message dispatch

Under some circumstances, usually in areas where it was deemed too dangerous to send a man, trained dogs were used to carry messages, secreted either in harnesses or simple collars.

Standard-format message form

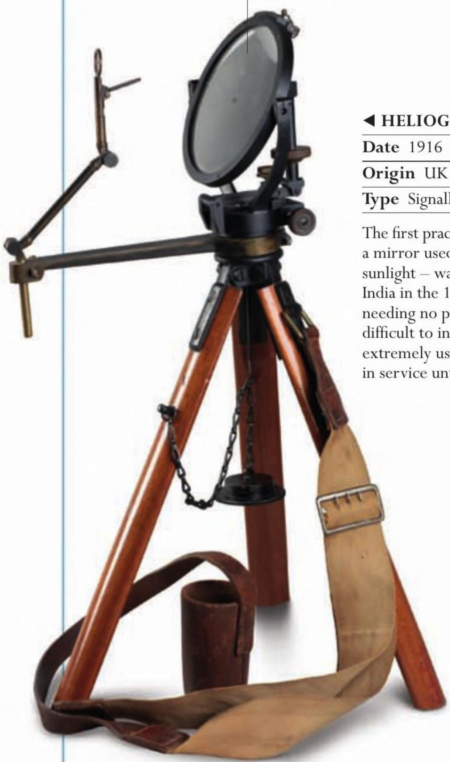
◀ MESSAGE PAD

Date 1914–1918

Origin UK

Type Message dispatch

Officers in the front line were supplied with message pads bound in leather and canvas covers. Carbon paper was used to produce a duplicate copy, which the sender retained.



Plane mirror

◀ HELIOGRAPH MARK V

Date 1916

Origin UK

Type Signalling

The first practical heliograph – a mirror used for flashing sunlight – was developed in India in the 1860s. Lightweight, needing no power source, and difficult to intercept, they were extremely useful and remained in service until the 1970s.

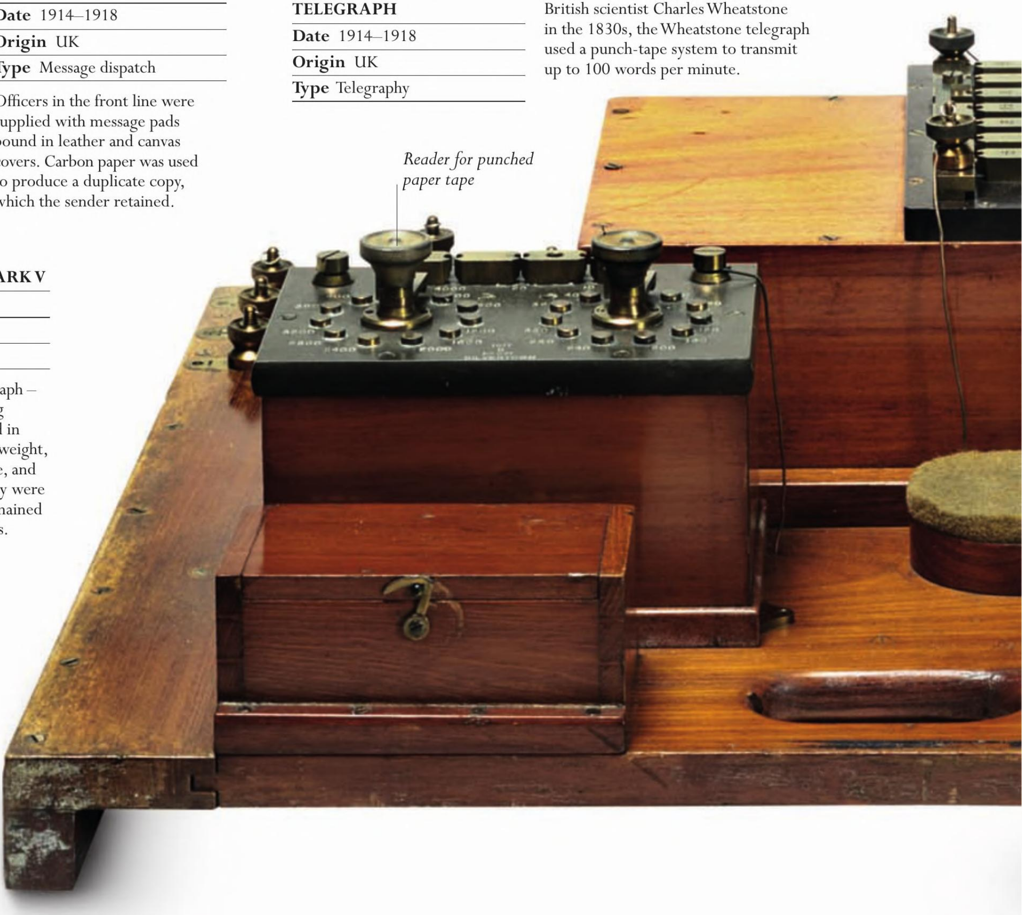
▼ WHEATSTONE TELEGRAPH

Date 1914–1918

Origin UK

Type Telegraphy

Based on technology developed by British scientist Charles Wheatstone in the 1830s, the Wheatstone telegraph used a punch-tape system to transmit up to 100 words per minute.



Reader for punched paper tape

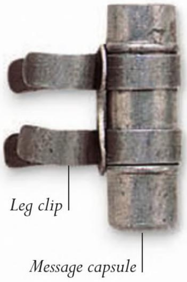
▶ PIGEON MESSAGE CAPSULE

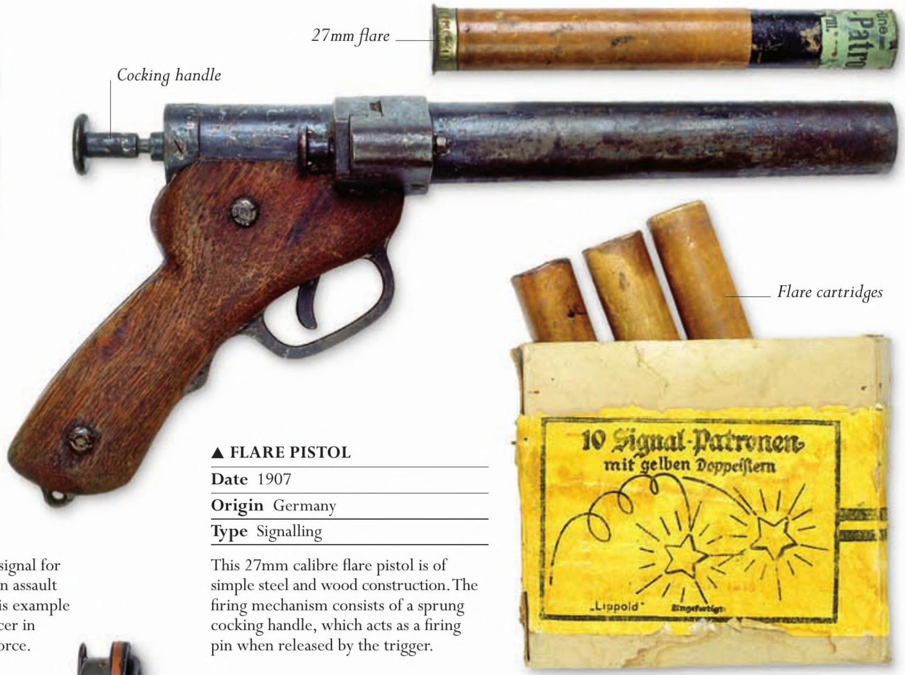
Date 1914–1918

Origin UK

Type Message dispatch

During the war, thousands of messenger pigeons were used by the British and German armies. Messages written on rice paper and folded to fit into containers such as this were attached to the birds' legs.


Leg clip
Message capsule


27mm flare
Cocking handle
Flare cartridges
10 Signal-Patronen
mit gelben Doppelstern
„Lippold"

▲ FLARE PISTOL

Date 1907

Origin Germany

Type Signalling

This 27mm calibre flare pistol is of simple steel and wood construction. The firing mechanism consists of a sprung cocking handle, which acts as a firing pin when released by the trigger.

Plaited cord lanyard

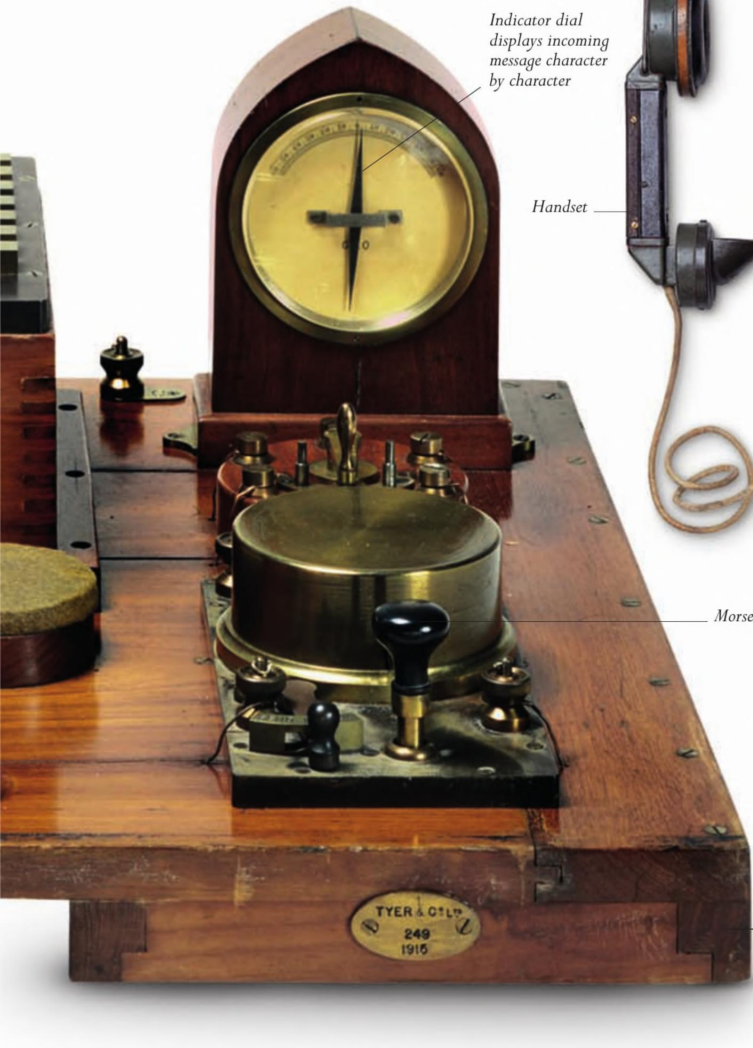
▲ SIGNALLING WHISTLE

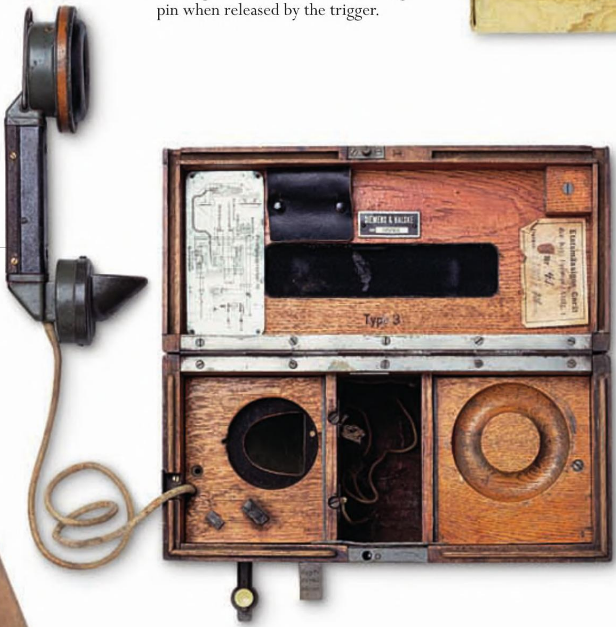
Date 1914

Origin UK

Type Signalling

A whistle-blast was the usual signal for pre-planned actions, such as an assault or a machine-gun barrage. This example was used by an Australian officer in the Egyptian Expeditionary Force.


Indicator dial displays incoming message character by character
Morse key
Wooden baseboard
TYER & Co LTD
249
1915


Handset
SIEMENS & HALSKE
Type 3

◀ FIELD TELEPHONE

Date 1914–1918

Origin Germany

Type Telephony

Field telephones were used extensively throughout World War I, mostly to allow front-line units to communicate with headquarters to the rear. However, they relied on cables that were extremely fragile and had to be repaired frequently.

Cutaway for the nose
Handle

◀ MEGAPHONE

Date 1915

Origin UK

Type Signalling

This loudhailer megaphone was recovered from the area known as Shrapnel Gulley at Anzac Cove on the Gallipoli Peninsula, together with other artefacts used by 2nd Field Company, Royal Australian Engineers, between 25 April and 20 December, 1915.

KEY **EVENTS**

1914–45

- **1915** The invention of the interrupter gear allows a pilot to fire a machine-gun through his propeller arc, leading to the development of the first fighter planes.
- **1935** The UK begins work on an air defence system, based on a chain of coastal radar stations, to give early warning of aerial threats.
- **1937** German aircraft intervening in the Spanish Civil War destroy the Basque town of Guernica by aerial bombing.
- **1938** The Boeing B-17 Flying Fortress (see pp.314–17) heavy bomber is introduced. This all-metal monoplane can carry a 2,700kg (6,000lb) bomb load.
- **1944** The German Messerschmitt Me 262 Schwalbe ("Swallow") is the first jet-engined fighter to enter service.
- **1945** American B-29 bombers drop atomic bombs on the Japanese cities of Hiroshima (see pp.378–79) and Nagasaki; Japan then surrenders.

KEY DEVELOPMENT

THE GROWTH OF AIR POWER

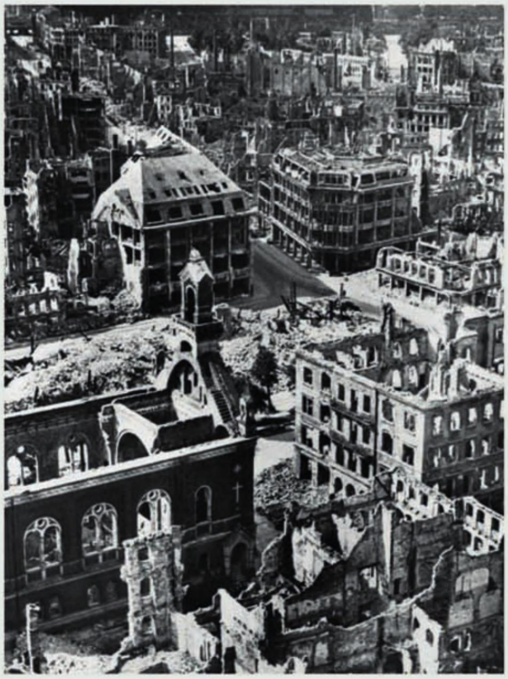
The most influential innovation in warfare between 1914 and 1945 was the development of air power. Combat aircraft became not only a vital adjunct to army and navy operations, but also an instrument for direct attack upon the enemy's homeland and infrastructure.

Although there had been a few minor uses of aircraft in war before 1914, it was World War I that saw the first true age of military aviation. The main combatants entered the war with about 500 flimsy flying machines between them. By 1918, the UK alone had 22,000 aircraft in service.

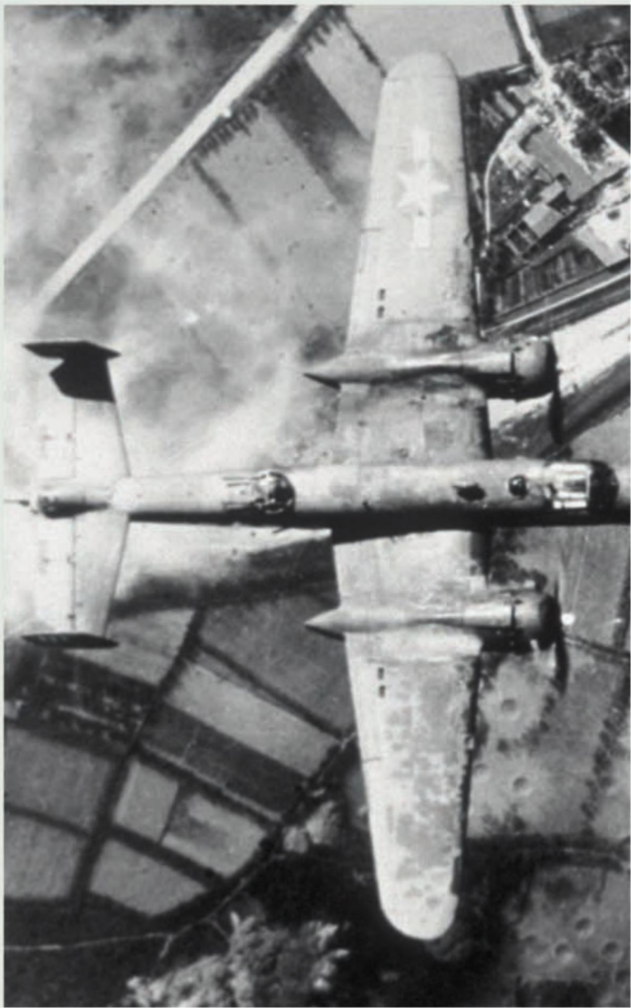
The prime functions of aircraft were that of reconnaissance and artillery spotting – giving army gunners feedback on where their shells had landed. Experimental raids were also mounted on targets behind enemy lines, with small bombs dropped by hand. Fighter aircraft were later sent up to shoot down bombers and reconnaissance planes, and, by 1916, fighters from opposing sides were engaged in aerial combat over the Western front. Air aces, the most successful fighter pilots, were celebrated as "knights of the air".

STRATEGIC BOMBING

Military chiefs soon realized that aircraft could also be used for strategic bombing – direct air attacks on enemy cities. Germany led the world in lighter-than-air flight, and their massive Zeppelin and Schütte-Lanz rigid airships launched night raids on London and other cities from 1915. Airships proved too slow-moving and vulnerable once the UK deployed night fighters in defence, and were replaced by heavier-than-air bomber aircraft. From



▸ **THE BOMBING OF DRESDEN**
In February 1945, some 1,300 Allied bombers attacked the German city of Dresden, causing a firestorm that killed around 25,000 people. The incident became a focus for criticism of strategic bombing.



> "Fighting in the air is **not sport**, it is **scientific murder**"
>
> **US PILOT EDDIE RICKENBACKER**, *FIGHTING THE FLYING CIRCUS,* 1919

1917, German Gothas heavy bombers attacked London and Paris, and, by the war's end, the UK and France were mounting their own bombing raids against German cities. After the war, some air commanders argued – wrongly – that future wars would be won by strategic bombing alone.

NEW AIRCRAFT

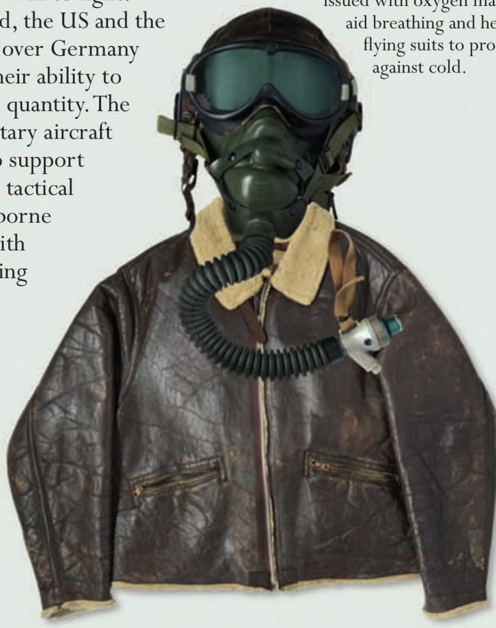
World War I airmen fought mostly in wood-and-canvas biplanes. During the 1930s, air forces were transformed by streamlined monoplanes – many of all-metal construction – with more powerful engines and improved performance. These new aircraft, including the Messerschmitt Bf 109 fighter and the dive-bombing Junkers Ju 87 Stuka, were first used by German forces in the Spanish Civil War (1936–39).

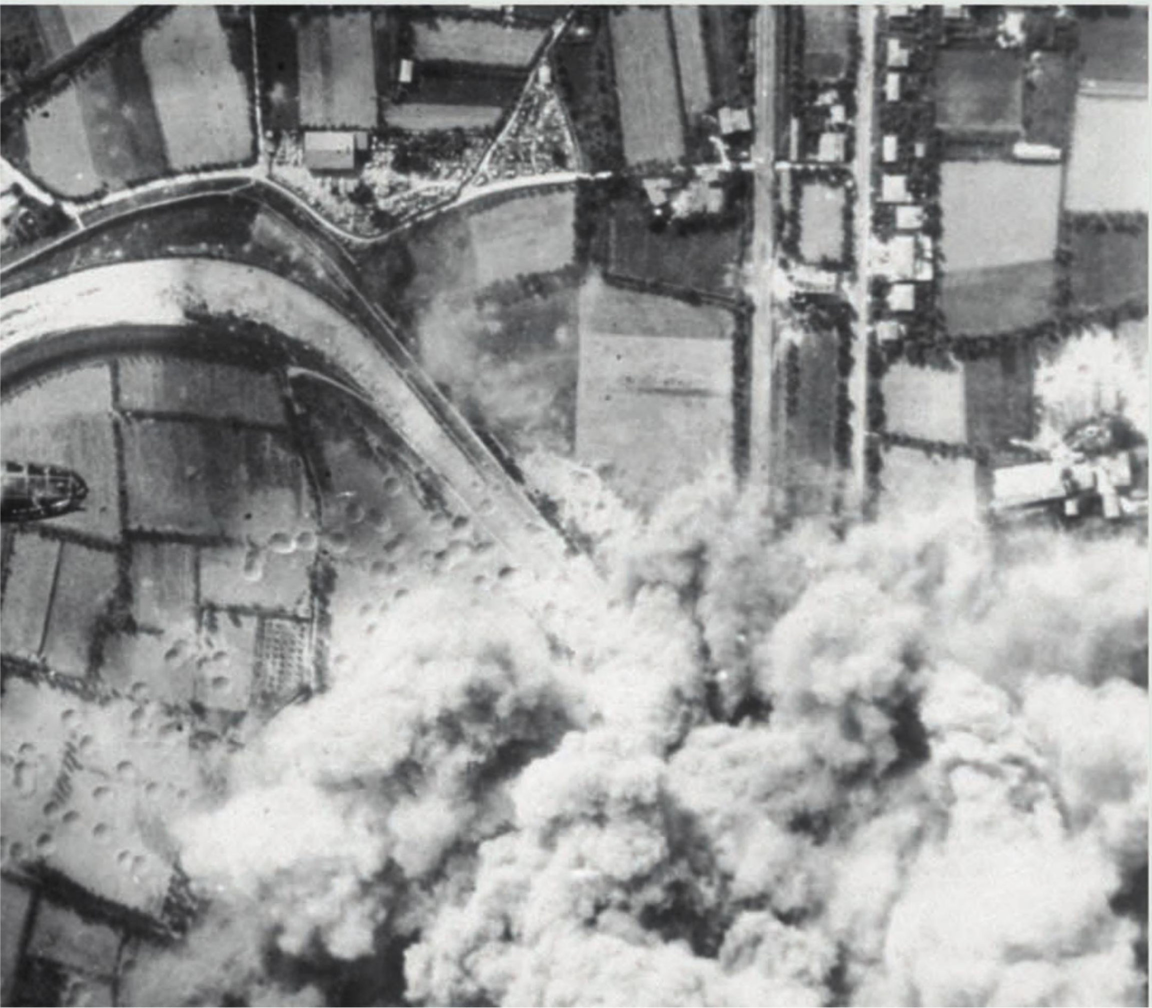
In the early years of World War II, from 1939 to 1941, Germany achieved a series of victories through coordinated air–ground warfare. This was based on radio contact between tanks and aircraft, operating as "aerial artillery". They also pioneered the use of airborne troops, landed by parachute or glider. However, the UK's radar-based air defence system enabled the Royal Air Force to prevent the *Luftwaffe* gaining command of the air in the Battle of Britain, in the summer of 1940. A sustained night bombing campaign against British cities, from September 1940 to May 1941, caused devastation, but failed to break the UK's will to fight.

As World War II progressed, the US and the UK achieved air superiority over Germany and Japan, chiefly through their ability to manufacture aircraft in huge quantity. The US built about 300,000 military aircraft during World War II, used to support operations in ground attack, tactical bombing, transport, and airborne troop landing roles, along with independent strategic bombing offensives. A day-and-night campaign by Allied bombers eventually reduced German cities to rubble, although still not to decisive effect.

Innovations such as the first jet aircraft or the first military helicopters were of marginal effect, but the arrival of the atomic bomb in 1945 heralded a new era in warfare.

▼ BOMBER CREW KIT
In World War II, American B-17 bomber crews flew at high altitude in unpressurized aircraft. They were issued with oxygen masks to aid breathing and heated flying suits to protect against cold.





KEY **FIGURE**

BARON VON RICHTHOFEN

1892–1918

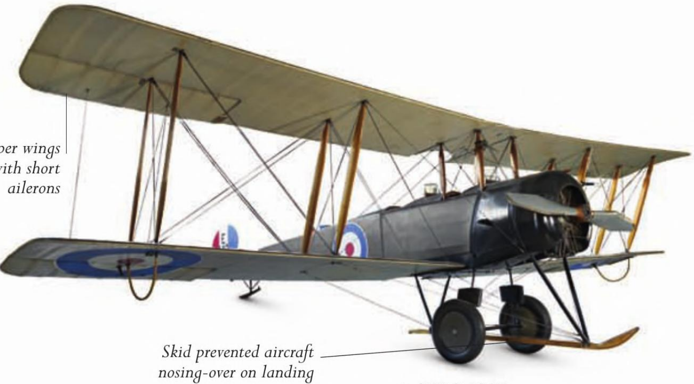
Germany's most famous World War I air ace, Manfred von Richthofen served as cavalry officer before becoming a fighter pilot. Credited with downing 80 enemy aircraft – more than any other pilot in the war – the "Red Baron" was himself shot down and killed in April 1918.

▲ Von Richthofen led a squadron that was nicknamed the "Flying Circus" due to its planes' bright colours; the baron himself flew a red Fokker Dr.I triplane.

◀ AMERICAN BOMBERS
A medium-range Mitchell B-25 bomber flies a bombing raid in France during World War II. Air superiority proved essential to the success of armies in combat.

RECONNAISSANCE AND FIGHTER AIRCRAFT

Initially, military aircraft were employed to observe the battlefield, but there was soon an imperative to control the airspace over it. The first aerial "dogfights" involved pistols and rifles, and were inconclusive. Machine-guns, which could be fired in bursts while the pilot corrected his aim, were the answer. However, it was not until a method was developed of allowing such weapons to follow the pilot's natural sightline, and fire through the propeller's arc, that the fighter aircraft really came into its own. The first such attempts saw propeller blades fitted with strips of steel to deflect bullets, but soon after "interrupter" mechanisms were developed, which shut off the gun while the blade passed through the line of fire.



Upper wings with short ailerons

Skid prevented aircraft nosing-over on landing

▲ **AVRO 504K**

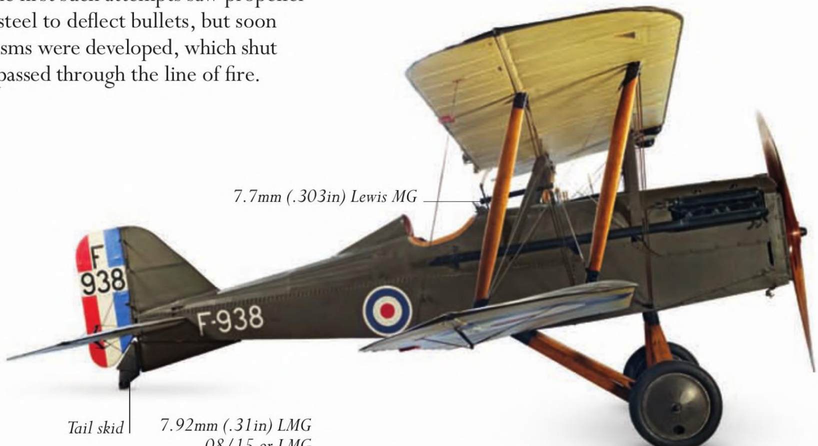
Date 1917 **Origin** UK
Wingspan 10.97m (36ft)
Length 8.97m (29½ft)
Top speed 145kph (90mph)
Engine 82kW (110hp)
Le Rhône 9Ja single-bank
9-cylinder rotary

Early versions of the Avro 504 served as reconnaissance and combat aircraft, but the two-seater 504K came into its own as a trainer. Over 10,000 were built over a period of almost 20 years.

▶ **S.E.5A**

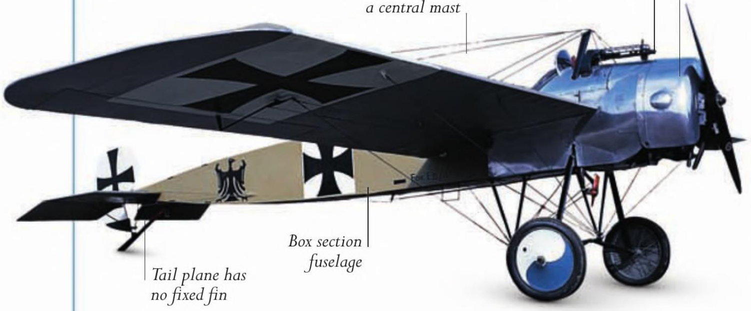
Date 1917 **Origin** UK
Wingspan 8.11m (26½ft)
Length 6.38m (21ft)
Top speed 225kph (140mph)
Engine 149.13kW (200hp)
Hispano-Suiza 8b or Wolseley
W4a "Viper" in-line V-8

The S.E.5a was an upgraded version of what was already an extremely powerful aircraft. It was superior to the contemporary Fokker D.VII in terms of stability and speed, and had much better high-altitude performance.



7.7mm (.303in) Lewis MG

Tail skid



7.92mm (.31in) LMG 08/15 or LMG 14 fires between propeller blades

Radial engine had "horseshoe" semi-cowl

Wing braced by cables anchored on a central mast

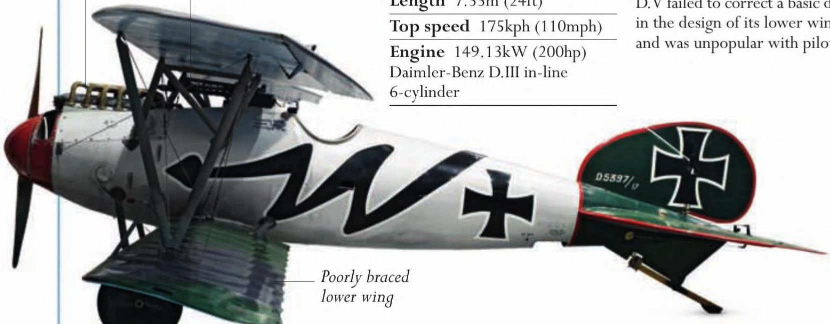
Box section fuselage

Tail plane has no fixed fin

◀ **FOKKER EII**

Date 1915 **Origin** Germany
Wingspan 8m (26¼ft)
Length 7.3m (24ft)
Top speed 150kph (93mph)
Engine 74.5kW (100hp)
Oberursel U.19 single-bank
9-cylinder rotary

Dutchman Anton Fokker's monoplane was an improved copy of the Morane-Saulnier. Its short-lived success was due solely to it being the first aircraft fitted with synchronizing interrupter gear for its gun.



6-cylinder in-line engine protrudes from faired-in nose

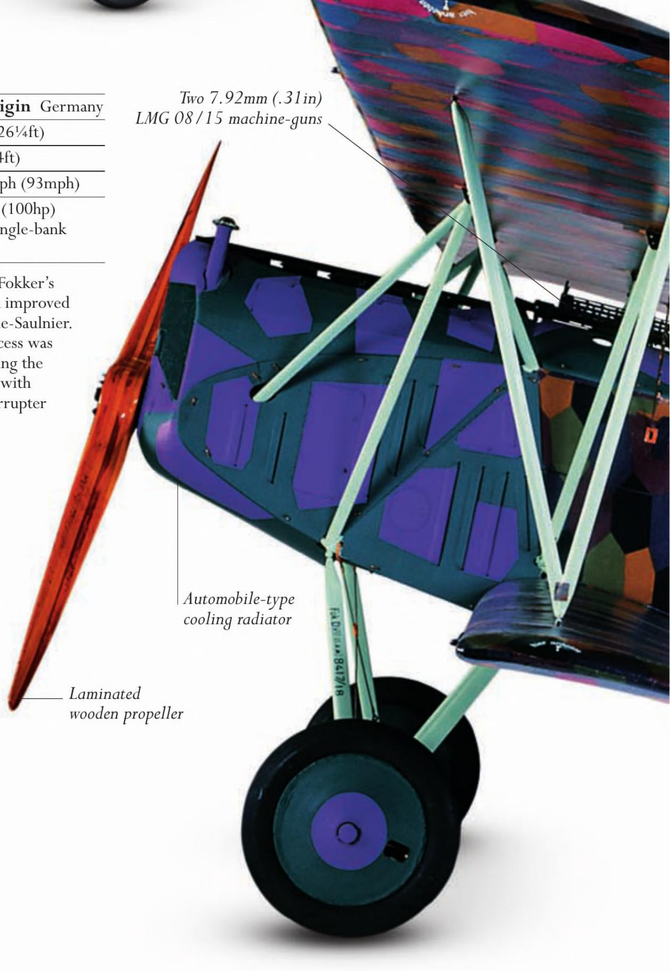
Two 7.92mm (.31in) LMG 08/15s

Poorly braced lower wing

▼ **ALBATROS D.V**

Date 1917 **Origin** Germany
Wingspan 9m (29½ft)
Length 7.33m (24ft)
Top speed 175kph (110mph)
Engine 149.13kW (200hp)
Daimler-Benz D.III in-line
6-cylinder

With a semi-monocoque plywood-skinned fuselage, the Albatros Type D was notably stiffer than frame-and-fabric designs, but the D.V failed to correct a basic defect in the design of its lower wing, and was unpopular with pilots.



"Fat" cantilevered wing section gave improved lift

Two 7.92mm (.31in) LMG 08/15 machine-guns

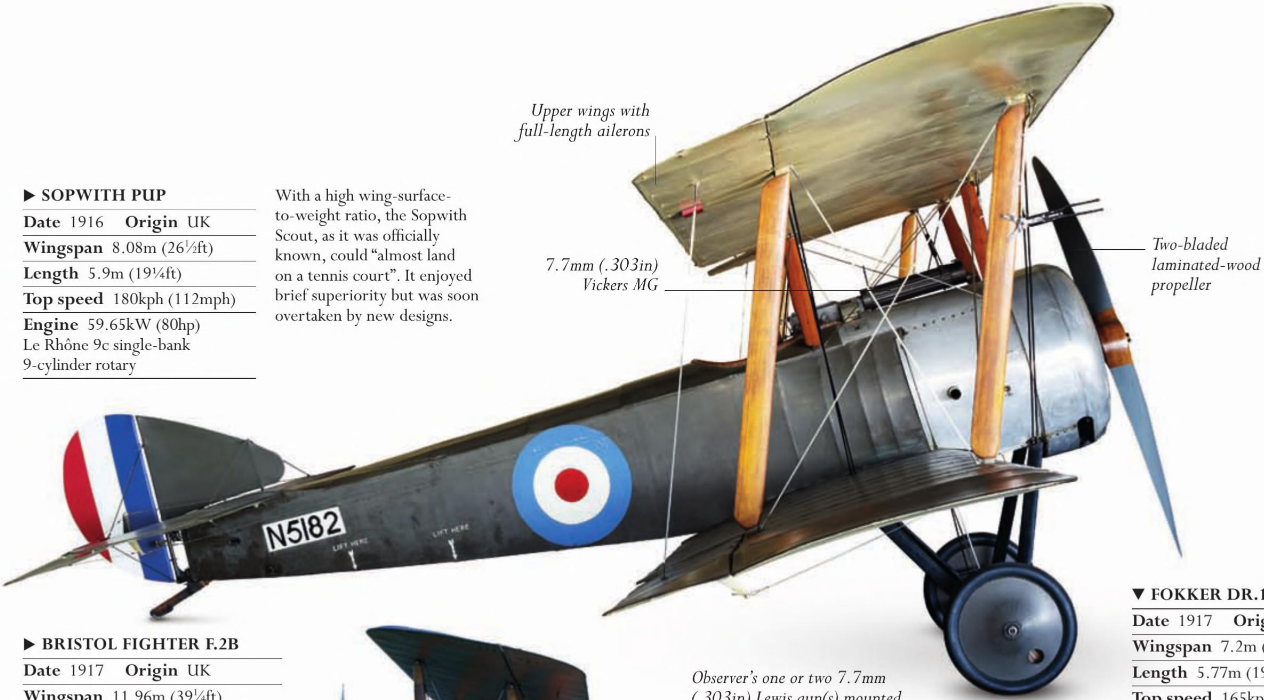
Automobile-type cooling radiator

Laminated wooden propeller

▶ SOPWITH PUP

Date 1916 **Origin** UK
Wingspan 8.08m (26½ft)
Length 5.9m (19¼ft)
Top speed 180kph (112mph)
Engine 59.65kW (80hp) Le Rhône 9c single-bank 9-cylinder rotary

With a high wing-surface-to-weight ratio, the Sopwith Scout, as it was officially known, could "almost land on a tennis court". It enjoyed brief superiority but was soon overtaken by new designs.



Upper wings with full-length ailerons

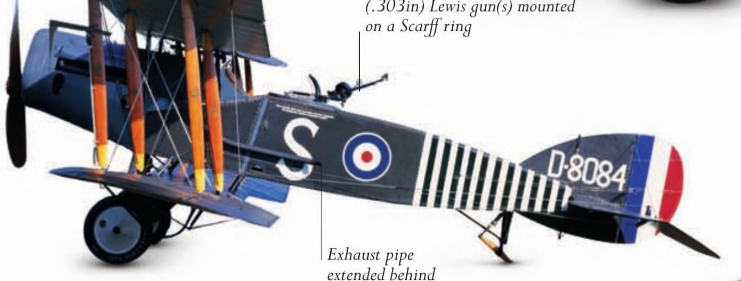
7.7mm (.303in) Vickers MG

Two-bladed laminated-wood propeller

▶ BRISTOL FIGHTER F.2B

Date 1917 **Origin** UK
Wingspan 11.96m (39¼ft)
Length 7.87m (25¾ft)
Top speed 198kph (123mph)
Engine 205kW (275hp) Rolls-Royce Falcon III in-line V-12

Thanks to its powerful engine, the second model of the Bristol Fighter, the F.2b, was one of the few two-seater fighters able to hold its own against opposition from single-seaters.



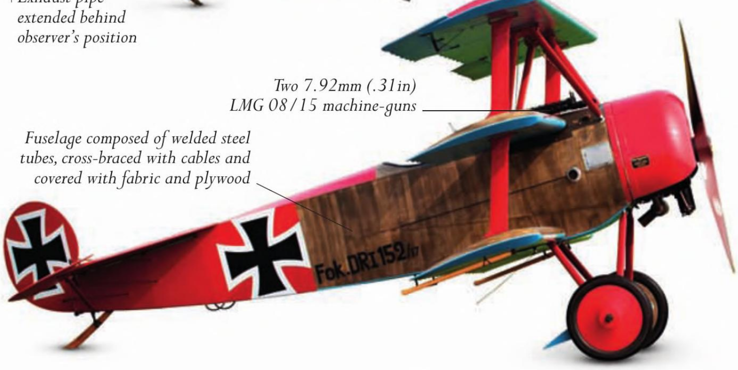
Observer's one or two 7.7mm (.303in) Lewis gun(s) mounted on a Scarff ring

Exhaust pipe extended behind observer's position

▼ FOKKER DR.1

Date 1917 **Origin** Germany
Wingspan 7.2m (23½ft)
Length 5.77m (19ft)
Top speed 165kph (103mph)
Engine 82kW (110hp) Oberursel UR II or Le Rhône 9J single-bank 9-cylinder rotary

After the success of the Sopwith Triplane, the three-wing format was adopted by the *Luftstreitkräfte* (German Air Force). The DR was flown by Manfred von Richthofen, the "Red Baron" (see p.301).



Two 7.92mm (.31in) LMG 08/15 machine-guns

Fuselage composed of welded steel tubes, cross-braced with cables and covered with fabric and plywood

◀ FOKKER D.VII

Date 1918 **Origin** Germany
Wingspan 8.93m (29¼ft)
Length 6.93m (22¾ft)
Top speed 190kph (118mph)
Engine 140kW (185hp) BMW IIIa in-line 6-cylinder

The last of the Fokkers, the Reinhold Platz-designed D.VII was considered by some to be the best fighter aircraft of World War I, but it struggled against the Sopwith Snipe and the Spad XII.

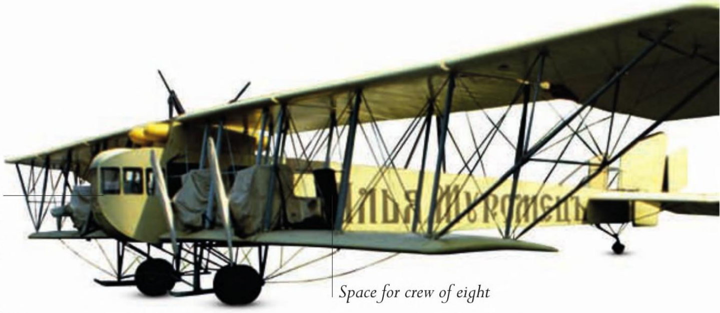
Large rudder with small, fixed triangular fin

Fuselage composed of fabric- and plywood-covered welded steel tubes

Tailplane had strengthening struts

BOMBER AIRCRAFT

Aircraft were first used to bomb ground targets during the Italian campaign to wrest Libya from the Ottoman Empire in 1911, but, as World War I progressed, it became imperative to produce machines designed specifically for the task. Progress was slow, however, and even by the war's end aerial bombardment was still a haphazard affair: only what was later known as "area bombing" of built-up areas was at all effective. Large aircraft were required to carry payloads over long distances, and, vulnerable to attack by fighters, they soon began to operate under cover of darkness.


Enclosed flight deck, with large cabin behind
Space for crew of eight

▲ SIKORSKY "ILYA MOUROMETZ"

Date 1915 **Origin** Russia

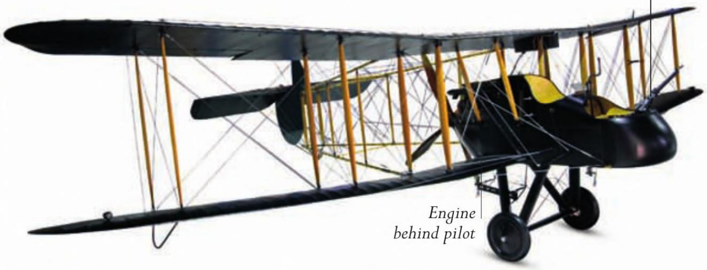
Wingspan 34.5m (113ft)

Length 17.5m (57½ft)

Top speed 110kph (68mph)

Engine Four 108.8kW (148hp) Sunbeam Crusader in-line V-8s

The great Russian designer Igor Sikorsky was responsible for the first four-engined aircraft; he built it as a commercial transport, but with war looming it was soon adapted as the basis for a heavy bomber. No two were identical.


Observer had two Lewis guns, one pointing forwards, the other up and to the rear
Engine behind pilot

▲ RAF F.E.2

Date 1915 **Origin** UK

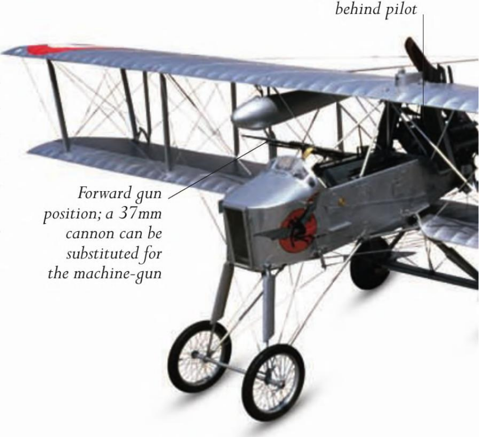
Wingspan 14.5m (47¾ft)

Length 9.8m (32¼ft)

Top speed 145kph (90mph)

Engine 107.6kW (160hp) Beardmore 6-cylinder

Originally intended as a fighter, the "pusher" F.E.2 was technically obsolete even before its prototype flew, but it proved to be a success as a light bomber. Over 2,000 were built.


Engine located behind pilot
Forward gun position; a 37mm cannon can be substituted for the machine-gun

▶ VOISIN 8

Date 1916 **Origin** France

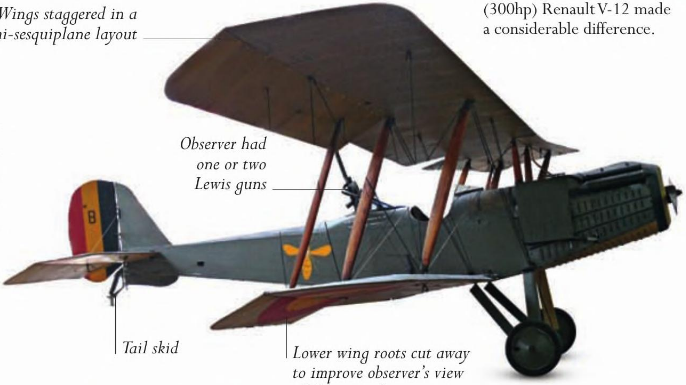
Wingspan 18.2m (61¾ft)

Length 11.02m (36¼ft)

Top speed 132kph (82mph)

Engine 161.8kW (220hp) Peugeot BAa in-line 8-cylinder

The French *Service Aéronautique Militaire*'s first purpose-built night bomber, the Voisin 8, was never more than mediocre, but many of its shortcomings could be traced to its Peugeot engine. Replacing it with a 220.6kW (300hp) Renault V-12 made a considerable difference.


Wings staggered in a semi-sesquiplane layout
Observer had one or two Lewis guns
Tail skid
Lower wing roots cut away to improve observer's view of the ground

▶ RAF R.E.8

Date 1916 **Origin** UK

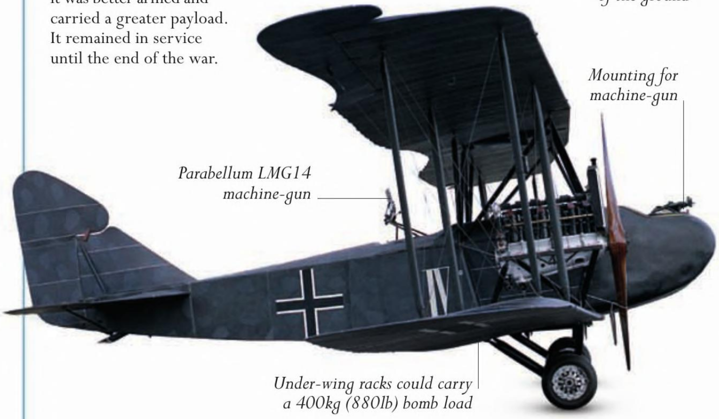
Wingspan 12.98m (42½ft)

Length 8.5m (27¾ft)

Top speed 165kph (103mph)

Engine 102.9kW (140hp) RAF 4a in-line V-12

The "Harry Tate" (rhyming slang for R.E.8; Tate was a music-hall artist) proved to be little more manoeuvrable than the aircraft it replaced (the B.E.2), but it was better armed and carried a greater payload. It remained in service until the end of the war.


Mounting for machine-gun
Parabellum LMG14 machine-gun
Under-wing racks could carry a 400kg (880lb) bomb load

◀ AEG G.IV

Date 1916 **Origin** Germany

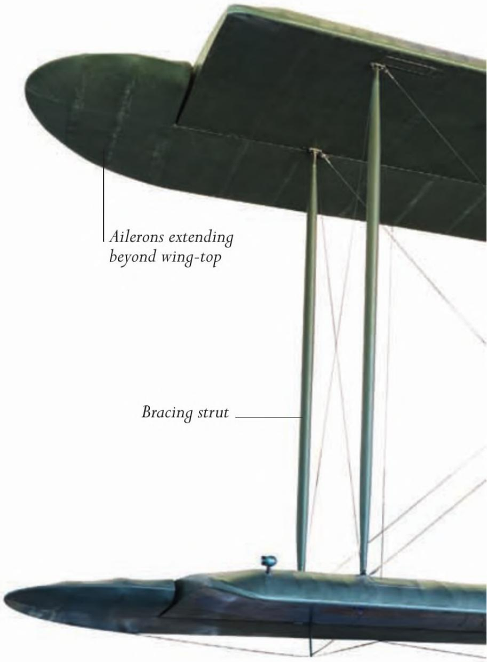
Wingspan 18.4m (60¼ft)

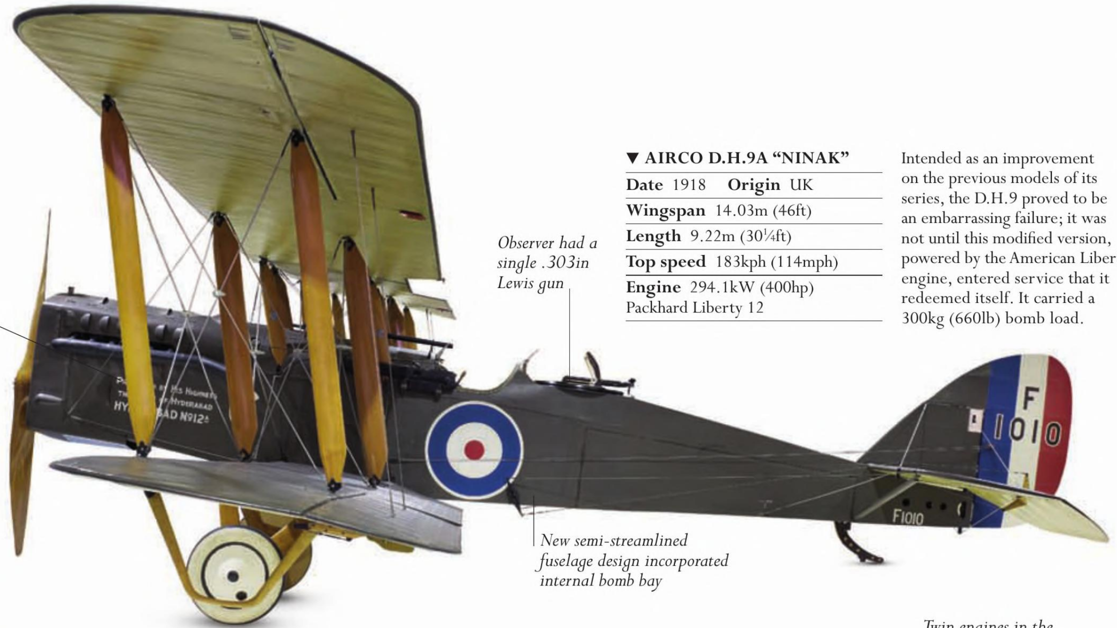
Length 9.7m (31¾ft)

Top speed 165kph (103mph)

Engine Two 191.2kW (260hp) Daimler-Benz D.Iva in-line 6-cylinders

While the limited range of the G.IV meant that it was used mainly as a tactical bomber attacking battlefield targets, it was also used on the Italian front to bomb cities, including Padua, Venice, and Verona.


Ailerons extending beyond wing-top
Bracing strut


PRESENTED BY HIS HIGHNESS THE NIZAM OF HYDERABAD HYDERABAD N°12
F 1010
F1010

American-made Liberty engine

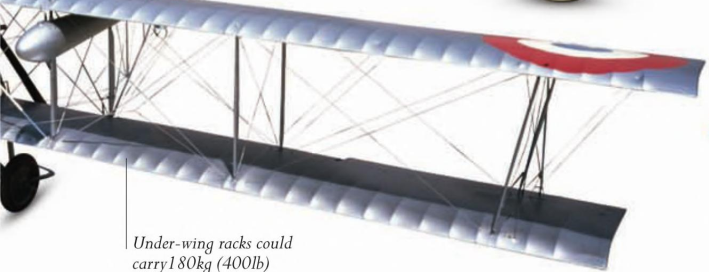
Observer had a single .303in Lewis gun

New semi-streamlined fuselage design incorporated internal bomb bay

▼ AIRCO D.H.9A "NINAK"

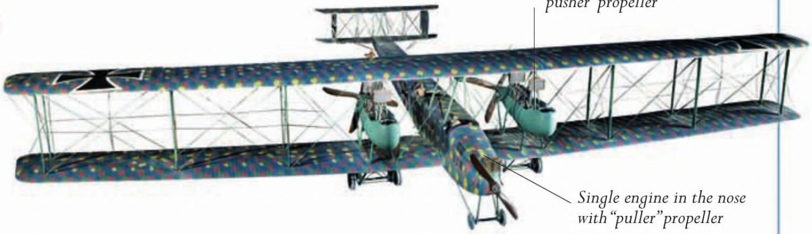
Date 1918 **Origin** UK
Wingspan 14.03m (46ft)
Length 9.22m (30¼ft)
Top speed 183kph (114mph)
Engine 294.1kW (400hp) Packhard Liberty 12

Intended as an improvement on the previous models of its series, the D.H.9 proved to be an embarrassing failure; it was not until this modified version, powered by the American Liberty engine, entered service that it redeemed itself. It carried a 300kg (660lb) bomb load.



Tail fin

Under-wing racks could carry 180kg (400lb) of bombs



Twin engines in the nose geared to a single "pusher" propeller

Single engine in the nose with "puller" propeller

▼ VICKERS VIMY

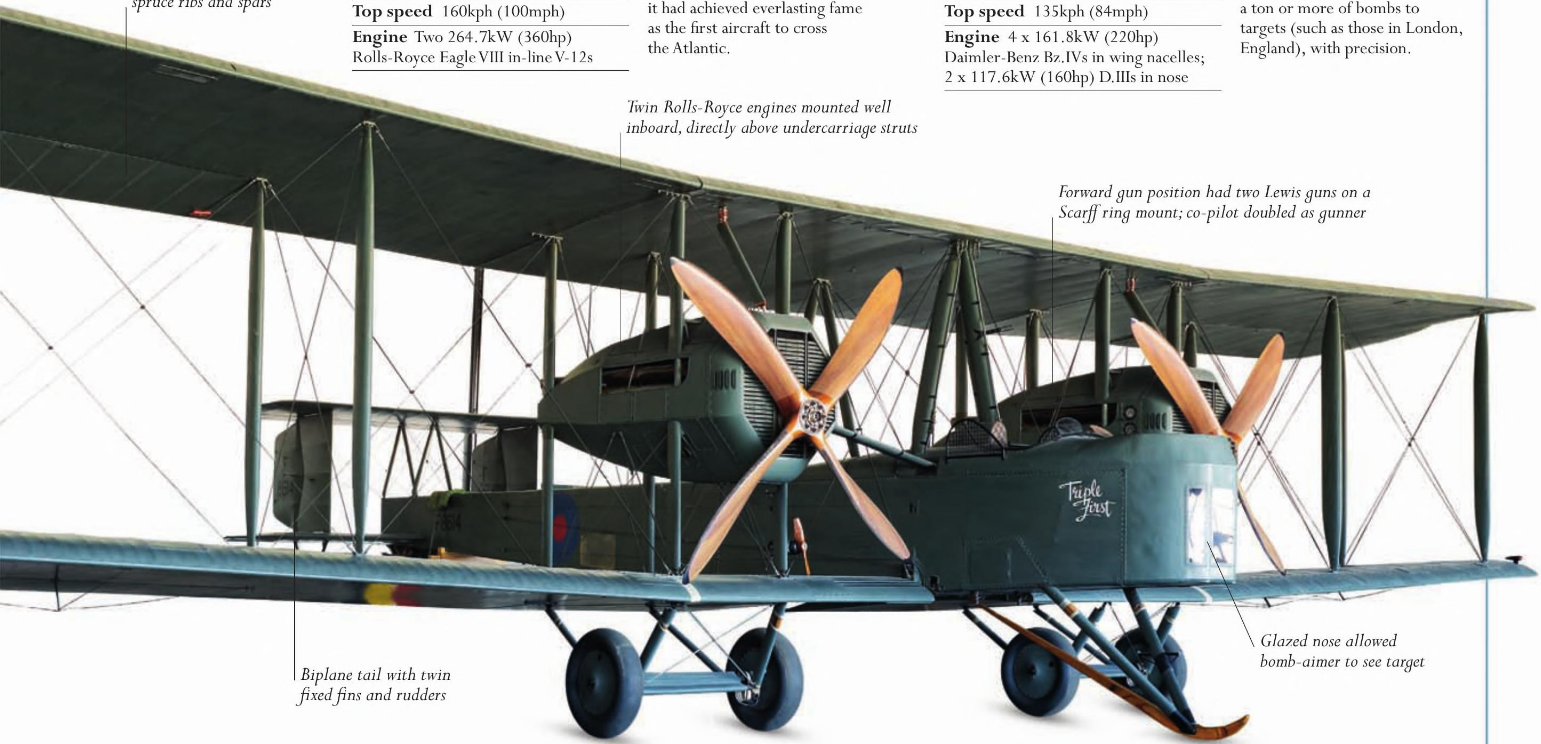
Date 1918 **Origin** UK
Wingspan 20.75m (68ft)
Length 13.28m (43½ft)
Top speed 160kph (100mph)
Engine Two 264.7kW (360hp) Rolls-Royce Eagle VIII in-line V-12s

The Vimy missed combat service during World War I by a matter of weeks, but it went on to be the British Royal Air Force's lead bomber until 1925. By that time it had achieved everlasting fame as the first aircraft to cross the Atlantic.

▲ ZEPPELIN STAAKEN

Date 1917 **Origin** Germany
Wingspan 42.2m (138½ft)
Length 22.1m (72½ft)
Top speed 135kph (84mph)
Engine 4 x 161.8kW (220hp) Daimler-Benz Bz.IVs in wing nacelles; 2 x 117.6kW (160hp) D.IIIs in nose

The most remarkable aircraft built for the *Luftstreitkräfte* (the German Air Force), the giant R-series Zeppelins had four, five, or six engines, and could deliver a ton or more of bombs to targets (such as those in London, England), with precision.



Wings made of plywood-covered spruce ribs and spars

Twin Rolls-Royce engines mounted well inboard, directly above undercarriage struts

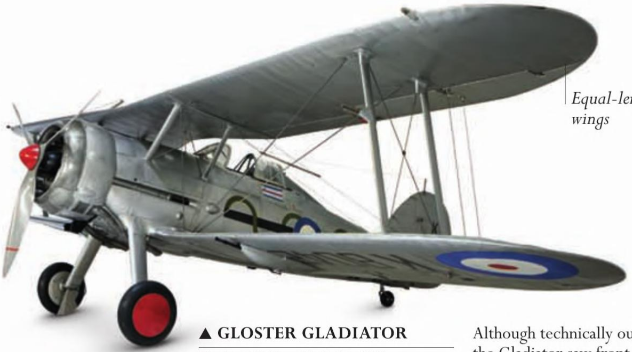
Forward gun position had two Lewis guns on a Scarff ring mount; co-pilot doubled as gunner

Glazed nose allowed bomb-aimer to see target

Biplane tail with twin fixed fins and rudders

FIGHTER AND FIGHTER-BOMBER AIRCRAFT 1939–42

Although much faster and more manoeuvrable than their predecessors, the fighter aircraft of 1918 were little changed from those of 1914. During the 1930s, all-metal monoplane fighters came into their own (a rare exception being the Hawker Hurricane, which had a fabric covering), with vastly more powerful engines, the ability to mount additional machine-guns, and heavier "cannon". By 1939, the most capable aircraft were reaching speeds in excess of 560kph (348mph), and could climb to 10,360m (34,000ft). Experts believed that such enhanced performance would put an end to the dogfights that were the essence of aerial combat during World War I, but they were soon proved wrong.



Equal-length wings

▲ GLOSTER GLADIATOR

Date 1937 **Origin** UK

Wingspan 9.83m (32¼ft)

Length 8.36m (27½in)

Top speed 415kph (255mph)

Engine 610.4kW (830hp) Bristol Mercury IX air-cooled single-bank 9-cylinder radial

Although technically outdated, the Gladiator saw front-line service with the RAF in France, Norway, and (most famously) Malta. It was also deployed by numerous other countries, including China, Finland, Norway, and Greece.

▶ SUPERMARINE SPITFIRE

Date 1939 **Origin** UK

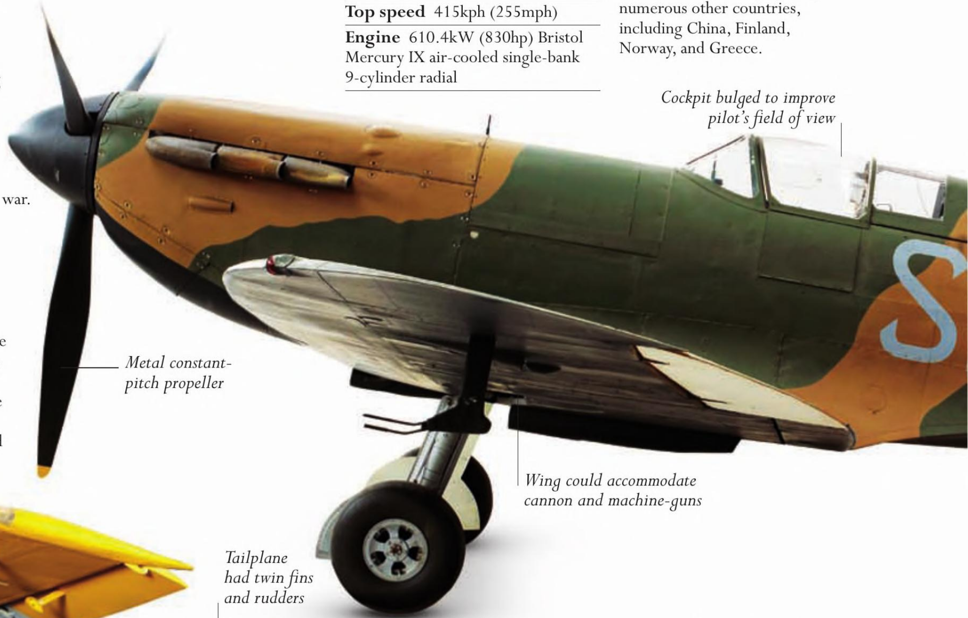
Wingspan 11.23m (36¾ft)

Length 9.12m (30ft)

Top speed 605kph (378mph)

Engine 1,081.1kW (1,470hp) Rolls-Royce Merlin 45 in-line V-12

The Spitfire's superb handling characteristics ensured its immediate success. Its continuous development – it was to be built in 13 main variants – kept it in service until well after the end of the war.



Cockpit bulged to improve pilot's field of view

Metal constant-pitch propeller

Wing could accommodate cannon and machine-guns

▼ MESSERSCHMITT BF 110

Date 1940 **Origin** Germany

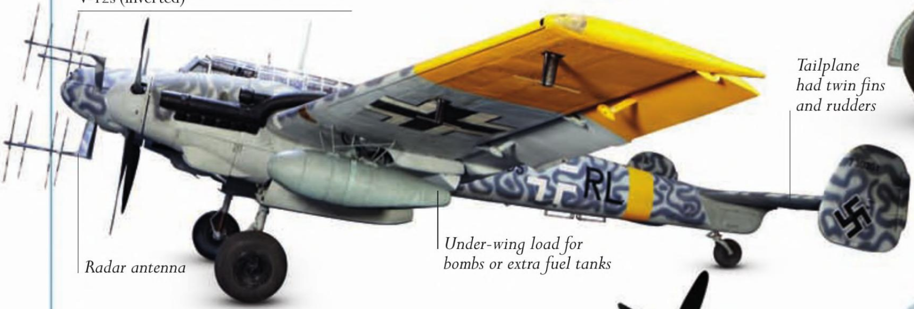
Wingspan 16.3m (53⅓ft)

Length 12.3m (40½ft)

Top speed 560kph (350mph)

Engine Two 809kW (1,100hp) Daimler-Benz DB 601A in-line V-12s (inverted)

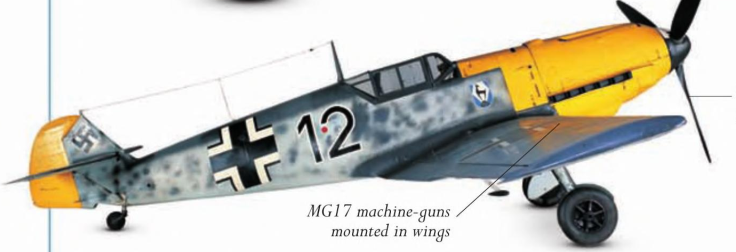
Designed originally as a long-range bomber escort, the early Bf 110 displayed serious shortcomings in that role. Later, -F and -G variants were significantly more successful, particularly as radar-equipped night-fighters.



Tailplane had twin fins and rudders

Radar antenna

Under-wing load for bombs or extra fuel tanks



Light alloy propeller

MG17 machine-guns mounted in wings

▲ MESSERSCHMITT BF 109

Date 1941 **Origin** Germany

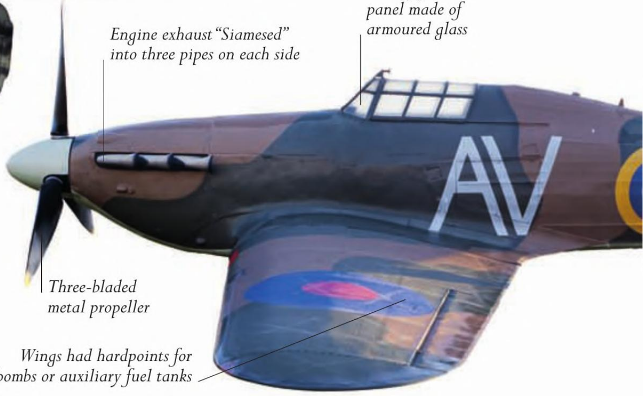
Wingspan 9.85m (32⅓ft)

Length 8.65m (28⅓ft)

Top speed 570kph (355mph)

Engine 956.1kW (1,300hp) Daimler-Benz DB 601E in-line V-12 (inverted)

The Bf 109 beat stiff competition to become the *Luftwaffe*'s first modern fighter aircraft. In all, some 35,000 were built in nine versions and many variants, with engines from Junkers or Daimler-Benz.



Canopy front panel made of armoured glass

Engine exhaust "Siamesed" into three pipes on each side

Three-bladed metal propeller

Wings had hardpoints for bombs or auxiliary fuel tanks

▶ FOCKE-WULF FW 190 WÜRGER

Date 1941 **Origin** Germany

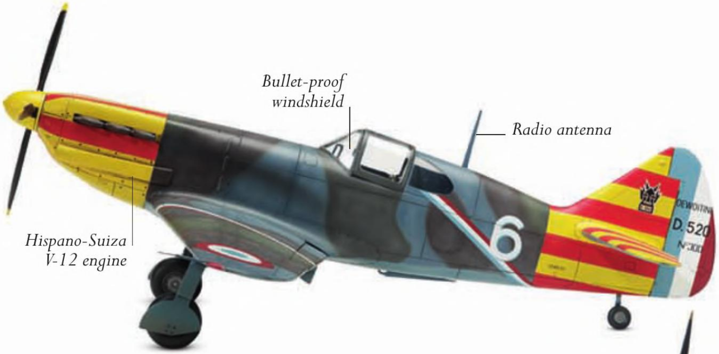
Wingspan 10.5m (34½ft)

Length 8.84m (29ft)

Top speed 655kph (410mph)

Engine 1,132.6kW (1,540hp) BMW 801C2 air-cooled 2-bank 14-cylinder radial

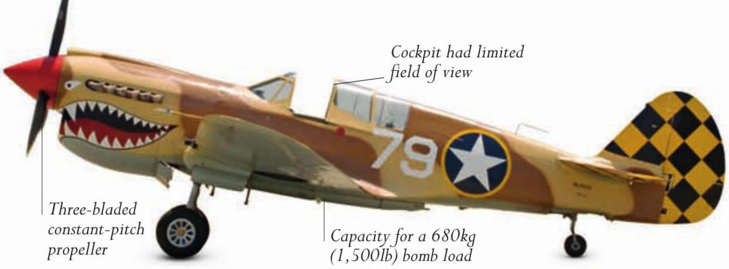
The most advanced fighter aircraft when it entered service, the Fw 190 remained unbeatable until confronted by the Spitfire Mk IX. An active development programme saw improved versions produced until 1945. The Fw 190 was the first important fighter of World War II to have a radial engine.


Bullet-proof windshield
Radio antenna
Hispano-Suiza V-12 engine

◀ DEWOITINE D.520

Date 1940 **Origin** France
Wingspan 10.2m (33½ft)
Length 8.6m (28¼ft)
Top speed 535kph (330mph)
Engine 687.6kW (935hp) Hispano-Suiza 12Y 45 in-line V-12

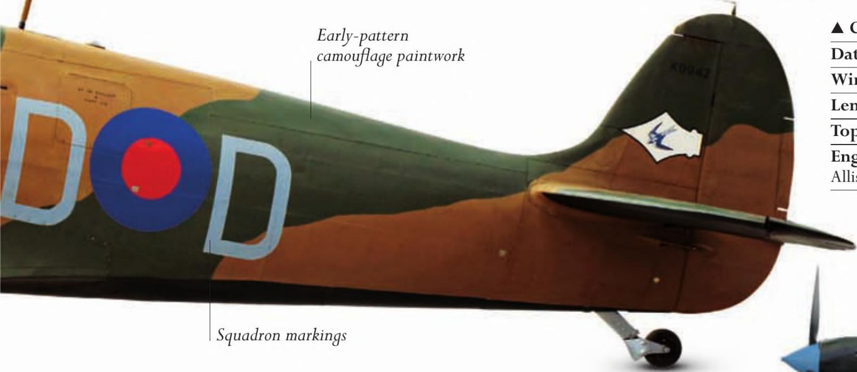
Without doubt the most capable fighter aircraft produced in France, the D.520 was a match for the Bf 109Es it fought in 1940, but only 400 had been produced before France capitulated. It had a service ceiling of 10,500m (34,500ft) and a range of 1,530km (950 miles).

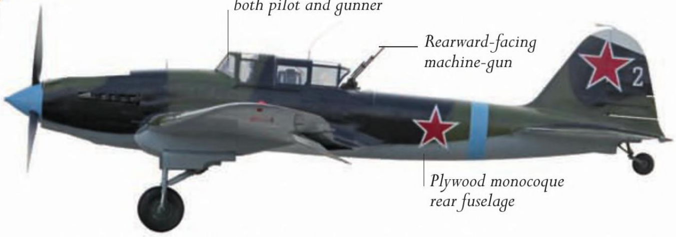

Cockpit had limited field of view
Three-bladed constant-pitch propeller
Capacity for a 680kg (1,500lb) bomb load

▲ CURTISS P-40 WARHAWK

Date 1941 **Origin** US
Wingspan 11.38m (37⅓ft)
Length 10.15m (33⅓ft)
Top speed 550kph (340mph)
Engine 882.5kW (1,200hp) Allison V-1710-81 in-line V-12

While respected for its agility, the Warhawk, even in its later variants, could not compete with the Messerschmitt Bf 109 or the Focke-Wulf Fw 190, which could attain higher altitudes. Nonetheless, it was the mainstay of the UK's Desert Air Force in North Africa, and saw action in China and the Southwest Pacific.


Radio antenna
Early-pattern camouflage paintwork
Squadron markings


Cockpit accommodated both pilot and gunner
Rearward-facing machine-gun
Plywood monocoque rear fuselage

◀ HAWKER HURRICANE

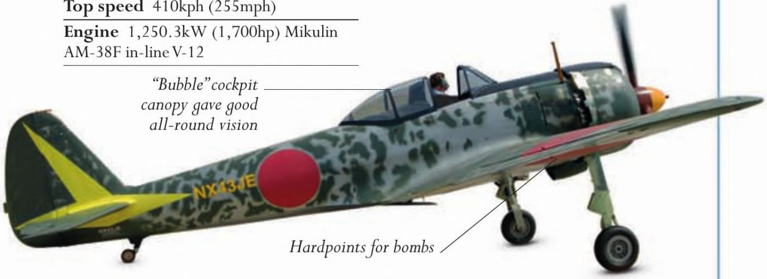
Date 1940 **Origin** UK
Wingspan 12.2m (40ft)
Length 9.85m (32¼ft)
Top speed 550kph (340mph)
Engine 871.5kW (1,185hp) Rolls-Royce Merlin XX V-12 in-line

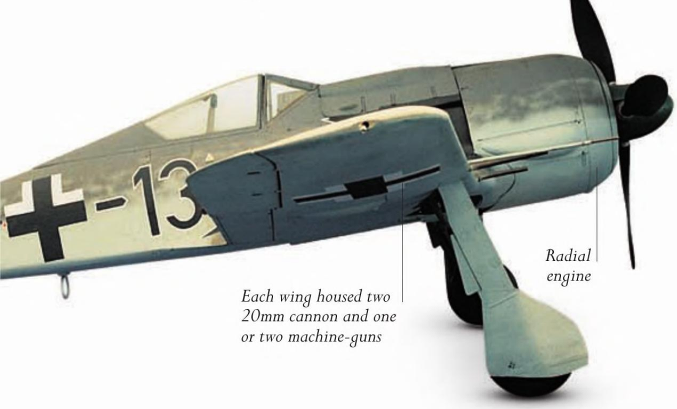
The Hurricane was something of an anomaly: a modern interceptor with a fuselage covered with fabric rather than sheet aluminium. It was much easier to produce and to repair than its all-metal Spitfire counterpart.

▲ ILYUSHIN IL-2 "SHTURMOVIK"

Date 1942 **Origin** Soviet Union
Wingspan 14.6m (47¾ft)
Length 11.6m (38ft)
Top speed 410kph (255mph)
Engine 1,250.3kW (1,700hp) Mikulin AM-38F in-line V-12

Built around a 700kg (1,540lb) armoured shell that contained the crew, engine, and fuel tank, the Il-2, the "flying tank", was designed purely as a ground-attack aircraft. Over 42,000 were constructed.


"Bubble" cockpit canopy gave good all-round vision
Hardpoints for bombs


Radial engine
Each wing housed two 20mm cannon and one or two machine-guns

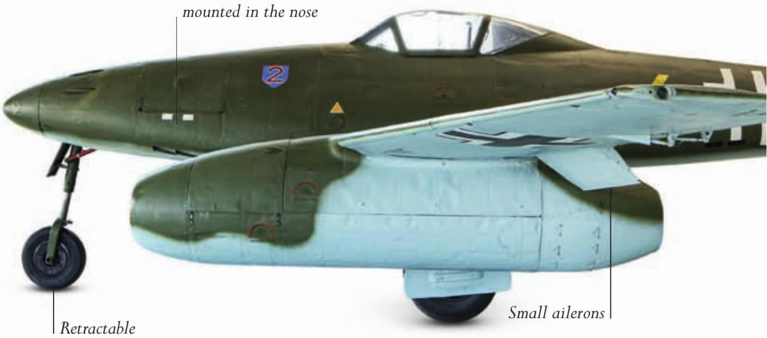
▲ NAKAJIMA KI-43 HAYABUSA "OSCAR"

Date 1942 **Origin** Japan
Wingspan 10.84m (35½ft)
Length 8.92m (29⅓ft)
Top speed 530kph (330mph)
Engine 845.8kW (1,150hp) Nakajima Ha-115 2-bank 14-cylinder radial

The Japanese Army's equivalent to the IJN's Mitsubishi A6M, the *Hayabusa* (Peregrine Falcon) weighed just 2.3 tonnes (2½ tons). Due to its light weight it was highly manoeuvrable and had an impressive rate of climb. The *Hayabusa* was well-regarded by its pilots, even though it was slow by contemporary standards and poorly armed.

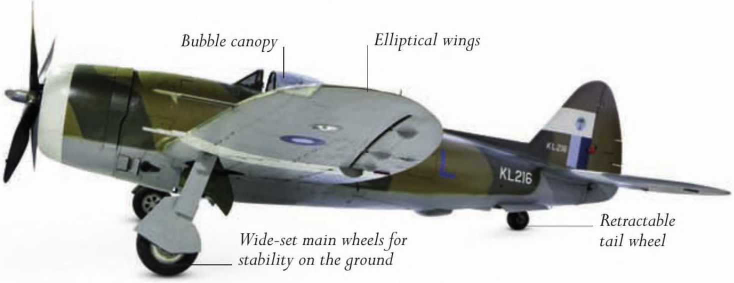
FIGHTER AND FIGHTER-BOMBER AIRCRAFT 1943–45

Some combatant nations – notably the Japanese – initially favoured lightweight, lightly armoured fighter aircraft, on the grounds that manoeuvrability was all-important; others preferred better protection and more powerful weaponry, and it was the latter that were to prove more effective. Such fighter aircraft were also more easily adapted to the ground-attack role, and this became increasingly important on both European fronts, and in the Pacific Theatre. After the brief appearance of rocket-powered aircraft, jet propulsion technology took its first faltering steps in aircraft of this type towards the war's end, and within ten years piston-engined fighters had all but disappeared.


Four 30mm cannon mounted in the nose

Retractable nose wheel

Small ailerons


Bubble canopy

Elliptical wings

Wide-set main wheels for stability on the ground

Retractable tail wheel

▲ REPUBLIC P-47 THUNDERBOLT

Date 1942 **Origin** US

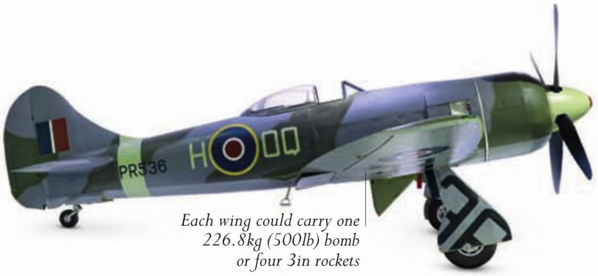
Wingspan 12.42m (40¾ft)

Length 11m (36ft)

Top speed 700kph (435mph)

Engine 1,890.3kW (2,535hp) Pratt & Whitney R-2800-59W Double Wasp radial

Nicknamed the "Jug" due to its bulky shape, the Thunderbolt was admired for its high-altitude performance – no German aircraft could out-dive it – and its ability to take punishment. It proved extremely effective as a ground-attack fighter-bomber.


Each wing could carry one 226.8kg (500lb) bomb or four 3in rockets

▲ HAWKER TEMPEST MK II

Date 1944 **Origin** UK

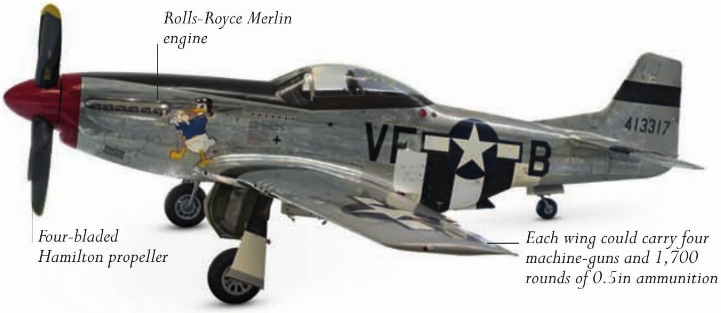
Wingspan 12.5m (41ft)

Length 10.26m (33½ft)

Top speed 695kph (432mph)

Engine 1,931.3kW (2,590hp) Bristol Centaurus V radial

The last and best of the British piston-engined fighter aircraft, the Tempest was a fast and manoeuvrable interceptor – capable of taking on the jet-powered Messerschmitts and Arados when deployed intelligently – while also excelling in the ground-attack role.


Rolls-Royce Merlin engine

Four-bladed Hamilton propeller

Each wing could carry four machine-guns and 1,700 rounds of 0.5in ammunition

▲ NORTH AMERICAN P-51 MUSTANG

Date 1943 **Origin** US

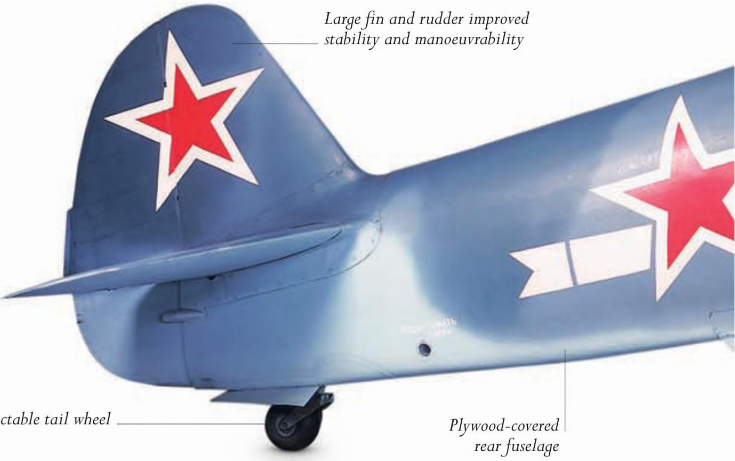
Wingspan 11.3m (37ft)

Length 9.83m (32¼ft)

Top speed 705kph (438mph)

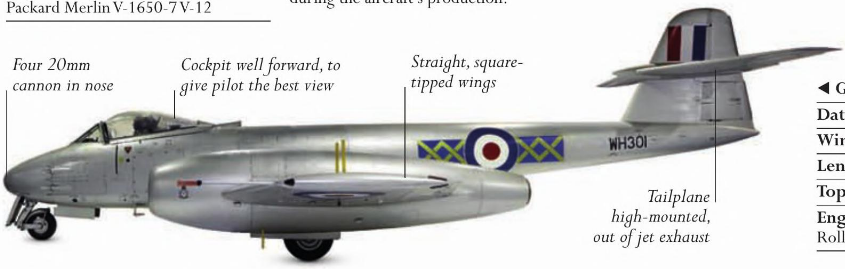
Engine 1,185.6kW (1,590hp) Packard Merlin V-1650-7 V-12

Produced in response to a request from the UK, the Mustang was an underachiever until it was fitted with a Rolls-Royce Merlin engine. It went on to become a mainstay of the US Army Air Forces, both as an escort and as a fighter-bomber. Its rear fuselage and tail were completely redesigned during the aircraft's production.


Large fin and rudder improved stability and manoeuvrability

Retractable tail wheel

Plywood-covered rear fuselage


Four 20mm cannon in nose

Cockpit well forward, to give pilot the best view

Straight, square-tipped wings

Tailplane high-mounted, out of jet exhaust

◀ GLOSTER METEOR

Date 1944 **Origin** UK

Wingspan 11.3m (37¼ft)

Length 13.6m (44½ft)

Top speed 965kph (600mph)

Engine Twin 1,590kg (3,500lb) Rolls-Royce Derwent turbojets

The Allies' first operational jet aircraft, the Meteor was the product of a long development programme. It saw active service in World War II and in Korea; its last variant was withdrawn as late as 1965.

Tailplane mounted high, out of jet exhaust

◀ MESSERSCHMITT ME 262 SCHWALBE

Date 1944 **Origin** Germany

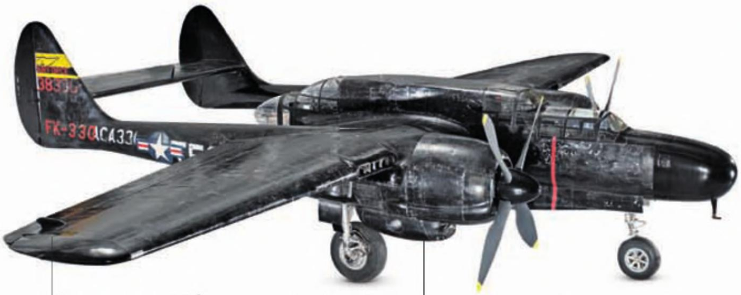
Wingspan 12.6m (41½ft)

Length 10.6m (34¾ft)

Top speed 870kph (540mph)

Engine Twin 900kg (1,985lb) Junkers Jumo 004B-1 turbojets

The first turbojet-powered combat fighter, the Me 262 quickly proved effective against the US Air Force's daylight bombing campaign, but it was produced too late to affect the outcome of the war.


Large wings needed for heavy aircraft (16 tons)
Four 20mm cannon in belly nacelle

▲ NORTHROP P-61 BLACK WIDOW

Date 1944 **Origin** US

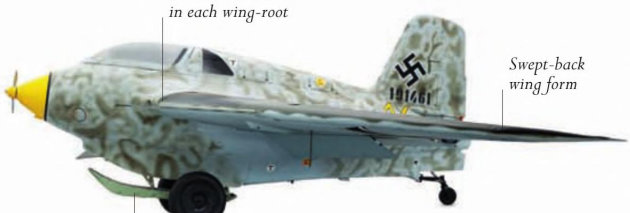
Wingspan 21.1m (66ft)

Length 15.1m (49½ft)

Top speed 590kph (365mph)

Engine Twin 1,677.8kW (2,250hp) Pratt & Whitney R-2800-65W Double Wasp radials

The P-61 was the first US aircraft designed as a night-fighter, and was the first aircraft specifically designed to carry radar for this purpose. It was capable of "loitering" in the skies for up to eight hours at a time.


One 30mm cannon in each wing-root
Swept-back wing form
Landing skid; wheels were dropped on take-off

◀ MESSERSCHMITT ME 163 KOMET

Date 1944 **Origin** Germany

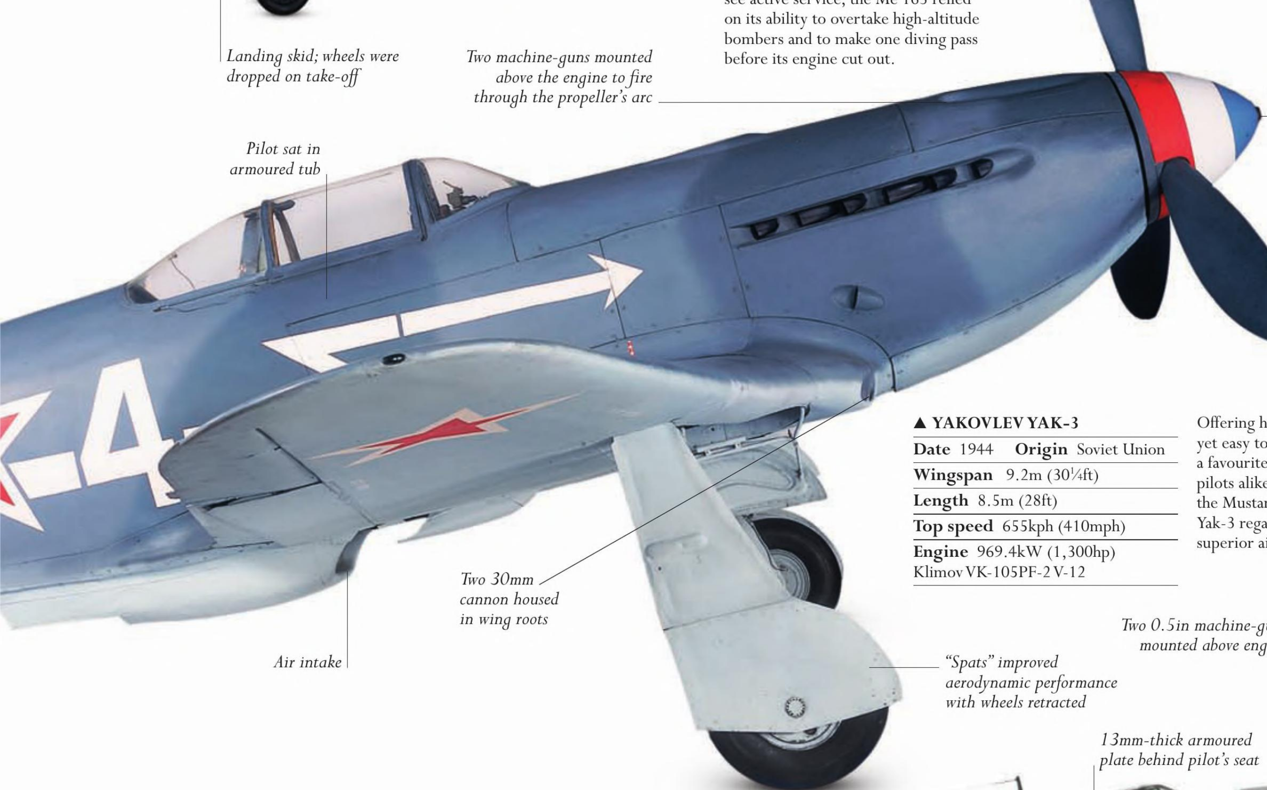
Wingspan 9.33m (30½ft)

Length 5.7m (18¾ft)

Top speed 960kph (600mph)

Engine 1,700kg (3,750lb) Walter HWK 109-509A-2 liquid-fuel rocket

The only rocket-powered aircraft to see active service, the Me 163 relied on its ability to overtake high-altitude bombers and to make one diving pass before its engine cut out.


Two machine-guns mounted above the engine to fire through the propeller's arc
20mm cannon fired through propeller boss
Pilot sat in armoured tub
Two 30mm cannon housed in wing roots
Air intake
"Spats" improved aerodynamic performance with wheels retracted

▲ YAKOVLEV YAK-3

Date 1944 **Origin** Soviet Union

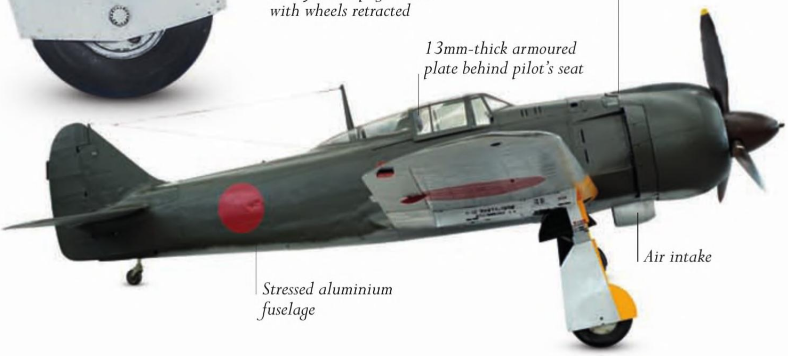
Wingspan 9.2m (30¼ft)

Length 8.5m (28ft)

Top speed 655kph (410mph)

Engine 969.4kW (1,300hp) Klimov VK-105PF-2 V-12

Offering high performance and yet easy to maintain, the Yak-3 was a favourite with ground-crew and pilots alike. Many pilots who flew the Mustang, the Spitfire, and the Yak-3 regarded the Yak as the superior aircraft.


Two 0.5in machine-guns mounted above engine
13mm-thick armoured plate behind pilot's seat
Air intake
Stressed aluminium fuselage

▶ KAWASAKI KI-100

Date 1945 **Origin** Japan

Wingspan 12m (39¼ft)

Length 8.8m (29ft)

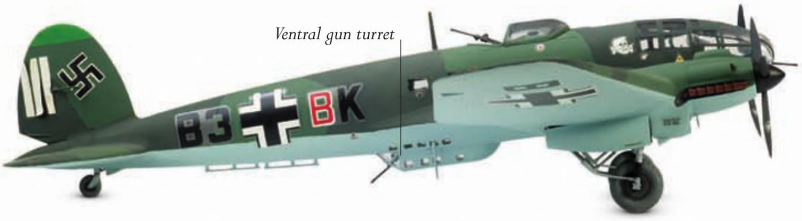
Top speed 580kph (360mph)

Engine 1,118.5kW (1,500hp) Mitsubishi Ha 112-II radial

Influenced by the German Focke-Wulf Fw 190, the Ki-100 was one of the best fighter aircraft the Japanese air force deployed during World War II – highly manoeuvrable and with a high altitude capacity. However, it came too late to make any difference to the outcome of the war.

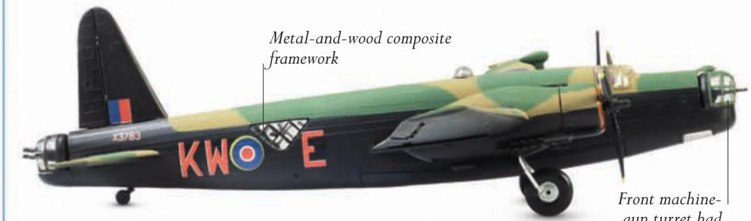
BOMBER AIRCRAFT 1939–42

During World War II, two different types of bomber aircraft emerged: those designed to fly long-range "strategic" missions against infrastructure targets, or drop bombs onto industrial cities in the hope of causing significant disruption to manufacturing; and "tactical" bombers, which were employed on and around the battlefield. Both had vital roles to play, but it was the "heavies", the four-engined aircraft capable of carrying many tons of bombs, which came to define the type. Aircraft such as these did not begin to enter service until war was already under way, operating alongside the twin-engined types, which had dominated production during the 1930s.


Ventral gun turret

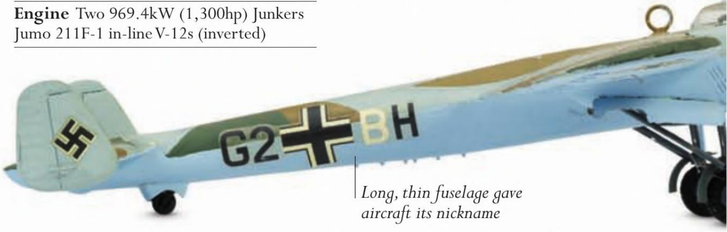
▲ HEINKEL HE 111
Date 1941 **Origin** Germany
Wingspan 22.6m (74ft)
Length 16.4m (54ft)
Top speed 440kph (275mph)
Engine Two 969.4kW (1,300hp) Junkers Jumo 211F-1 in-line V-12s (inverted)

The most numerous of the medium bombers with which the *Luftwaffe* entered the war, the He 111 was built in a bewildering array of variants, the most outlandish of which was the twin-fuselage, five-engined He 111Z.


Metal-and-wood composite framework
Front machine-gun turret had power traverse

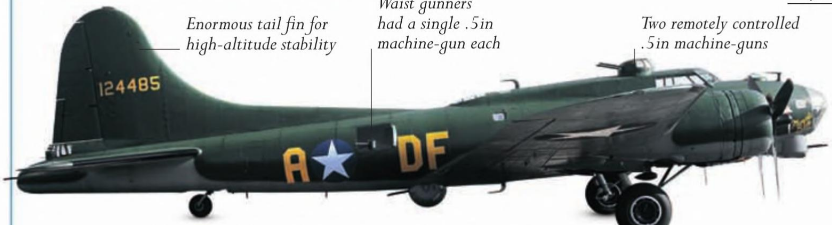
▲ VICKERS WELLINGTON
Date 1941 **Origin** UK
Wingspan 26.26m (86⅙ft)
Length 18.54m (61ft)
Top speed 410kph (255mph)
Engine Two 1,118.5kW (1,500hp) Bristol Hercules XI two-bank 14-cylinder radials

The "Wimpy", as it was universally known, had a fabric-covered metal-and-wood airframe, which was light and very strong but took a long time to assemble. It remained in combat service with the UK's Royal Air Force Bomber Command until October 1943.


Long, thin fuselage gave aircraft its nickname

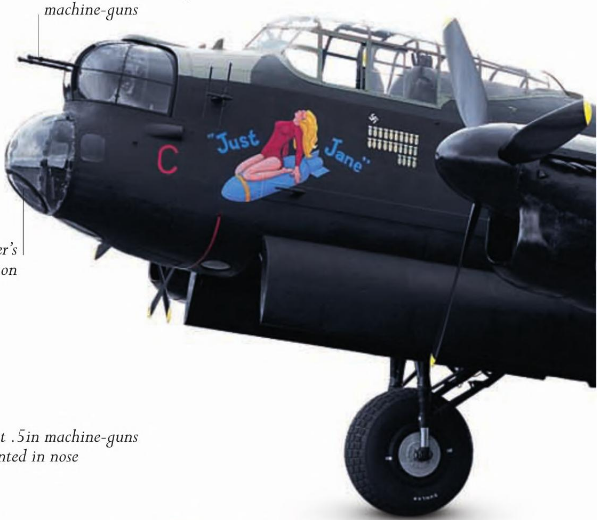
▲ DORNIER DO.17
Date 1938 **Origin** Germany
Wingspan 18m (59ft)
Length 15.79m (52ft)
Top speed 410kph (255mph)
Engine Twin 745.7kW (1,000hp) BMW Bramo 323P "Fafnir" single-bank 9-cylinder radials

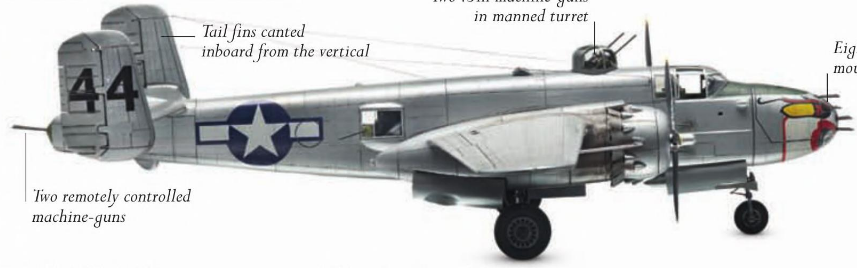
The Do.17 – the "Flying Pencil" – was relatively unimportant when compared to other German bombers of the early war years, especially the He 111. Thanks to its agility, however, it was a favourite with its crew.


Enormous tail fin for high-altitude stability
Waist gunners had a single .5in machine-gun each
Two remotely controlled .5in machine-guns

▲ BOEING B-17 FLYING FORTRESS
Date 1943 **Origin** US
Wingspan 31.62m (103¾ft)
Length 22.66m (74⅓ft)
Top speed 460kph (285mph)
Engine Four 894.8kW (1,200hp) Wright R-1820-97 Cyclone single-bank 9-cylinder radials

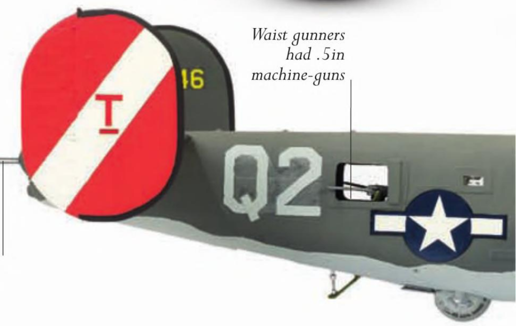
Famed for its ability to absorb damage, the Flying Fortress's (see pp.314–17) weakness was its limited bomb load – just half that of the Lancaster. Bristling with guns, Fortresses flew in "combat box" formation for mutual defence against fighters during daylight raids.

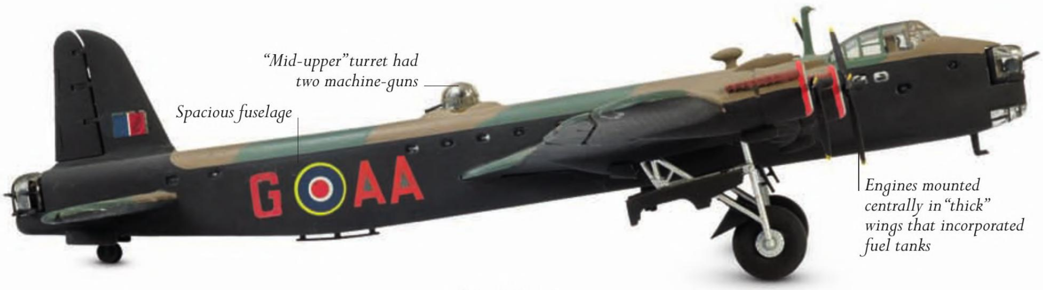

Two .303in Browning machine-guns
Bomb-aimer's position


Tail fins canted inboard from the vertical
Two .5in machine-guns in manned turret
Eight .5in machine-guns mounted in nose
Two remotely controlled machine-guns

▲ B-25 MITCHELL
Date 1943 **Origin** US
Wingspan 20.6m (67½ft)
Length 16.45m (54ft)
Top speed 438kph (272mph)
Engine Two 1,267.6kW (1,700hp) Wright R-2600-92 Cyclone two-bank 14-cylinder radials

With war imminent, the US Army Air Corps ordered the B-25 Mitchell medium bomber "off the drawing board", without waiting for a prototype. Eventually, almost 10,000 were built in six main variants, including the B-25H/J gunships, which had up to 18 machine-guns and a 75mm cannon.


Waist gunners had .5in machine-guns
Two .5in machine-guns in rear turret

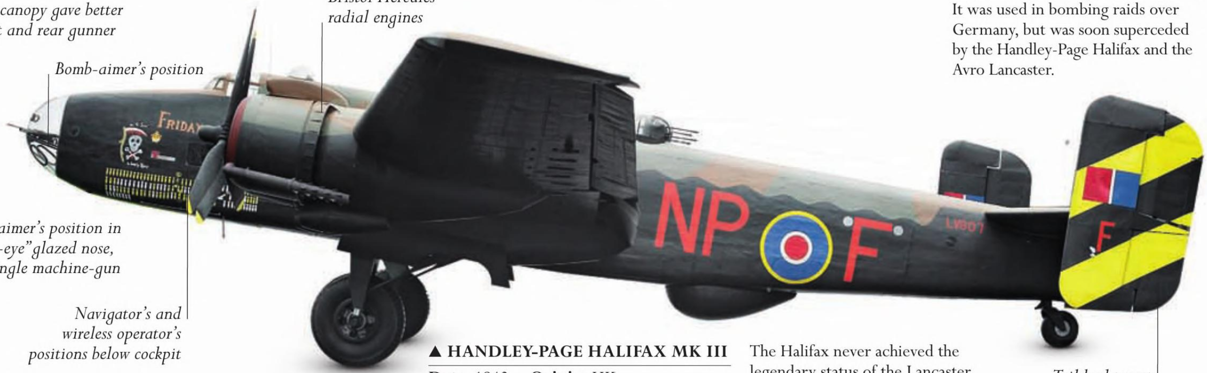

"Mid-upper" turret had two machine-guns
Spacious fuselage
Engines mounted centrally in "thick" wings that incorporated fuel tanks
G AA

◀ SHORT STIRLING MK I

Date 1940 **Origin** UK
Wingspan 30.2m (99ft)
Length 26.6m (87¼ft)
Top speed 410kph (255mph)
Engine Four 768.1kW (1,030hp) Bristol Hercules II two-bank 14-cylinder radials

The Short Stirling was the first of the British Royal Air Force's "heavies" to reach operational service. It was used in bombing raids over Germany, but was soon superceded by the Handley-Page Halifax and the Avro Lancaster.

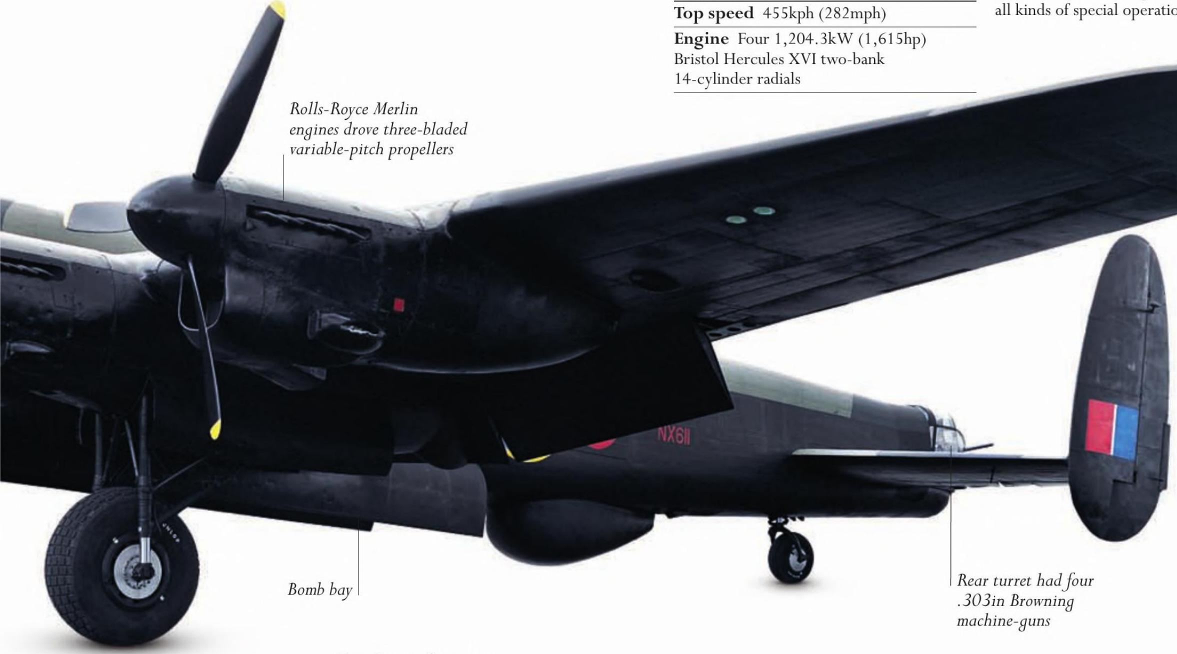
Enlarged cockpit canopy gave better visibility for pilot and rear gunner


Bristol Hercules radial engines
Bomb-aimer's position
Bomb-aimer's position in "beetle-eye" glazed nose, with single machine-gun
Navigator's and wireless operator's positions below cockpit
Tail had turret containing four machine-guns
FRIDAY
NP F
LV907
F

▲ HANDLEY-PAGE HALIFAX MK III

Date 1942 **Origin** UK
Wingspan 31.75m (104¼ft)
Length 21.82m (71½ft)
Top speed 455kph (282mph)
Engine Four 1,204.3kW (1,615hp) Bristol Hercules XVI two-bank 14-cylinder radials

The Halifax never achieved the legendary status of the Lancaster, even though it was more versatile and preceded it into service. It carried out maritime patrols and all kinds of special operations.


Rolls-Royce Merlin engines drove three-bladed variable-pitch propellers
Bomb bay
Rear turret had four .303in Browning machine-guns
NX611

◀ AVRO LANCASTER

Date 1942 **Origin** UK
Wingspan 31.09m (102ft)
Length 21.11m (69⅓ft)
Top speed 460kph (285mph)
Engine Four 954.5kW (1,280hp) Rolls-Royce Merlin XX in-line V-12s

Perhaps the best bomber aircraft of World War II, the Lancaster carried a 6,350kg (14,000lb) bomb load to targets in Germany and beyond from British Royal Air Force Bomber Command's bases in the east of England.

Two .5in machine-guns in dorsal turret
Forward gun turret

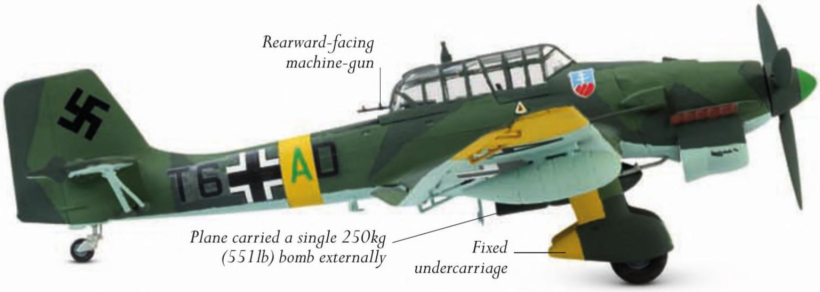
◀ CONSOLIDATED B-24 LIBERATOR

Date 1943 **Origin** US
Wingspan 33.5m (110ft)
Length 20.6m (67⅔ft)
Top speed 470kph (290mph)
Engine Four 894.8kW (1,200hp) Pratt & Whitney R-1830-65 Twin Wasp two-bank 14-cylinder radials

Lighter, faster, and with a greater carrying capacity than the B-17, the Liberator was to be the most prolific Allied bomber of World War II. However, it was harder to fly than the Flying Fortress, and was never as popular with crews.

BOMBER AIRCRAFT 1943–45

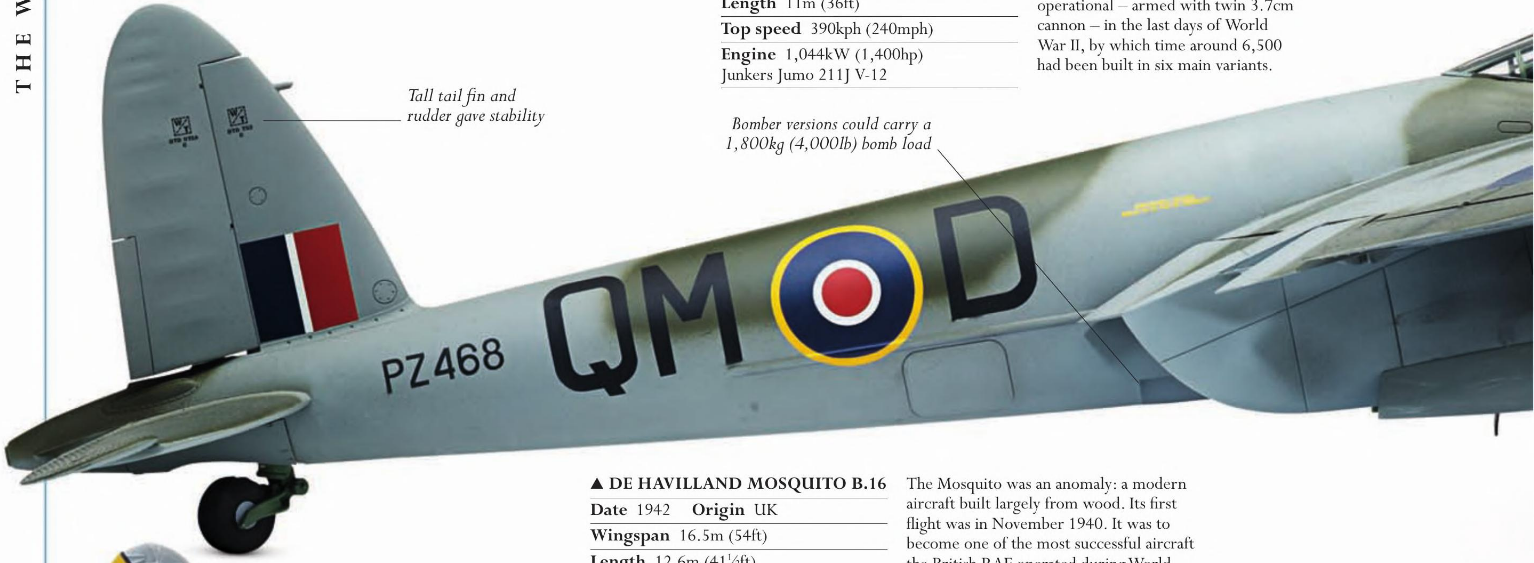
Strategic bombers evolved during the course of World War II, their capacities enhanced by the development of more powerful engines, and their capabilities improved by the introduction of radar-based guidance systems and the first effective predictive bombsights. By 1944, the best of these could deliver heavy bomb loads with great accuracy onto targets thousands of miles from their home bases, but they were still sustaining major losses – the British Royal Air Force (RAF) Bomber Command alone lost over 12,000 aircraft during the course of the war.


Rearward-facing machine-gun
Plane carried a single 250kg (551lb) bomb externally
Fixed undercarriage
T6+AD

▲ JUNKERS JU 87D STUKA

Date 1941 **Origin** Germany
Wingspan 13.8m (45½ft)
Length 11m (36ft)
Top speed 390kph (240mph)
Engine 1,044kW (1,400hp) Junkers Jumo 211J V-12

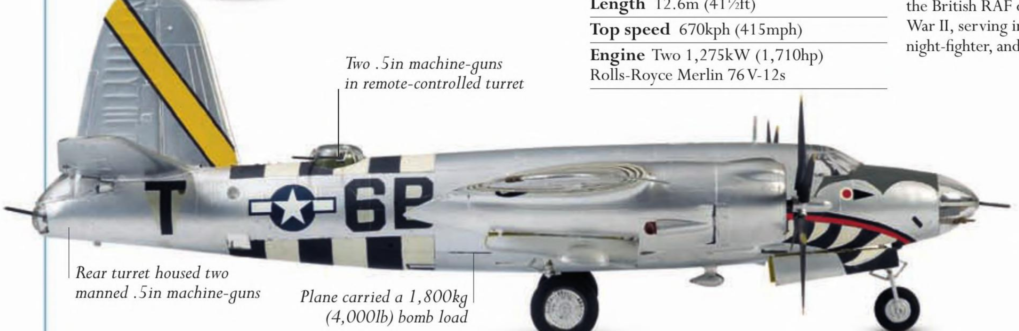
Perhaps the most recognizable of all German aircraft of the period, the Ju 87 *Sturzkampfflugzeug* first saw combat in Spain, in 1937. It was still operational – armed with twin 3.7cm cannon – in the last days of World War II, by which time around 6,500 had been built in six main variants.


Tall tail fin and rudder gave stability
Bomber versions could carry a 1,800kg (4,000lb) bomb load
PZ468
QM D

▲ DE HAVILLAND MOSQUITO B.16

Date 1942 **Origin** UK
Wingspan 16.5m (54ft)
Length 12.6m (41½ft)
Top speed 670kph (415mph)
Engine Two 1,275kW (1,710hp) Rolls-Royce Merlin 76 V-12s

The Mosquito was an anomaly: a modern aircraft built largely from wood. Its first flight was in November 1940. It was to become one of the most successful aircraft the British RAF operated during World War II, serving in bomber, day- and night-fighter, and reconnaissance roles.


Two .5in machine-guns in remote-controlled turret
Rear turret housed two manned .5in machine-guns
Plane carried a 1,800kg (4,000lb) bomb load
T 6P

◀ MARTIN B-26 MARAUDER

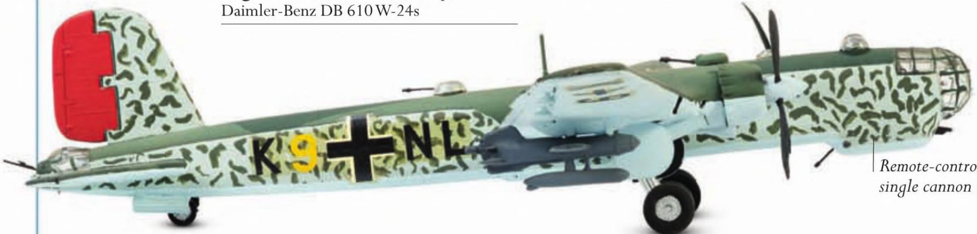
Date 1942 **Origin** US
Wingspan 21.65m (71ft)
Length 17.8m (58¼ft)
Top speed 460kph (290mph)
Engine Two 1,417kW (1,900hp) Pratt & Whitney R-2800-43 Double Wasp radials

The Marauder was designed and operated as a medium bomber. It saw service in the Pacific Theatre, Europe, and the Mediterranean. Despite being difficult to fly and having stability problems early on, due to a poorly designed fin, it ended the war with the lowest loss rate of any US Army Air Force aircraft.

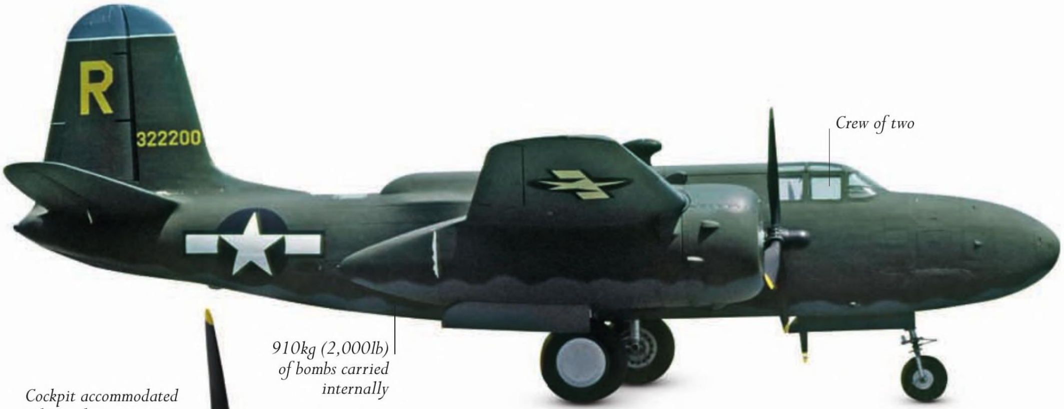
▼ HEINKEL HE 177 GRIEF

Date 1942 **Origin** Germany
Wingspan 31.45m (103ft)
Length 22m (72¼ft)
Top speed 565kph (350mph)
Engine Two 1,939kW (2,600hp) Daimler-Benz DB 610 W-24s

The *Grief* (Griffin) was the only purpose-built long-range heavy bomber operated by the *Luftwaffe* during World War II. An inspired design that was flawed in execution, many of its shortcomings could be traced to its over-complicated engine and to the requirement that it function as a precision dive bomber.


Remote-controlled ventral gondola housed a single cannon and a single machine-gun
K9+NL

Two .5in machine-guns
4623
A



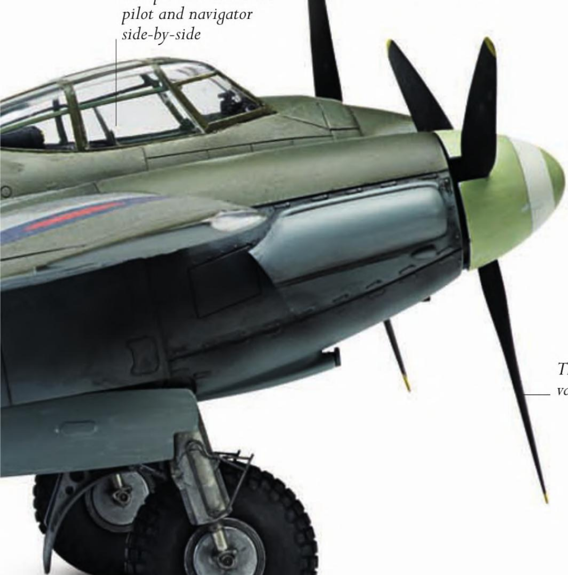
Crew of two

910kg (2,000lb) of bombs carried internally

◀ DOUGLAS A-20 HAVOC

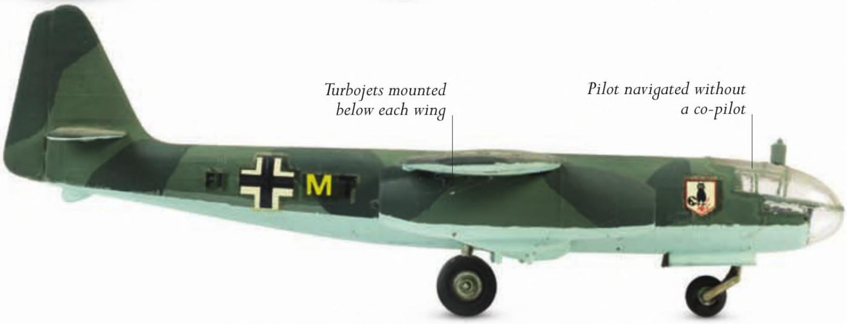
Date 1942 **Origin** US
Wingspan 18.7m (61⅓ft)
Length 14.6m (48ft)
Top speed 549kph (340mph)
Engine Two 1,267.7kW (1,700hp) Wright R2600-A Twin Cyclone radials

The Havoc – "Boston" to the British RAF, which also operated it – was intended as a light/attack bomber, but also saw service as a night-fighter. A total of almost 7,500 were built by Douglas and Boeing between late 1939 and September 1944.



Cockpit accommodated pilot and navigator side-by-side

Three-bladed variable-pitch propeller



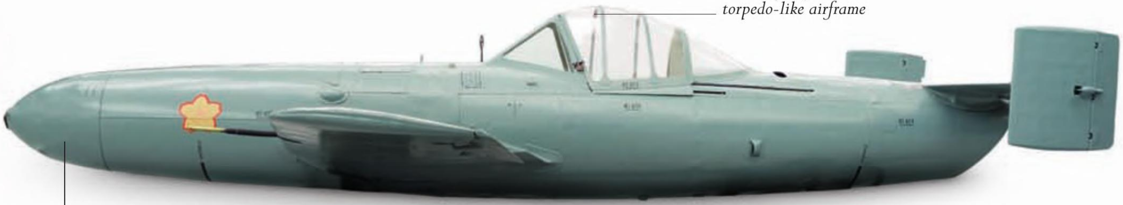
Turbojets mounted below each wing

Pilot navigated without a co-pilot

▲ ARADO AR 234B-2

Date 1944 **Origin** Germany
Wingspan 14.1m (46¼ft)
Length 12.63m (41½ft)
Top speed 740kph (460mph)
Engine Two 900kg (1,985lb) Junkers Jumo 004B-1 turbojets

The second turbojet to enter service with the *Luftwaffe*, the Ar 234B-2 first flew in June 1943. Within a year it had proved to be a capable reconnaissance aircraft, and while this became its main role, it also flew a number of bombing missions, most notably an attempt to destroy the last remaining Rhine Bridge at Remagen.



Pilot very exposed in torpedo-like airframe

Warhead contained 1,200kg (2,650lb) of Amatol high explosive

▲ YOKOSUKA MXY7 OHKA

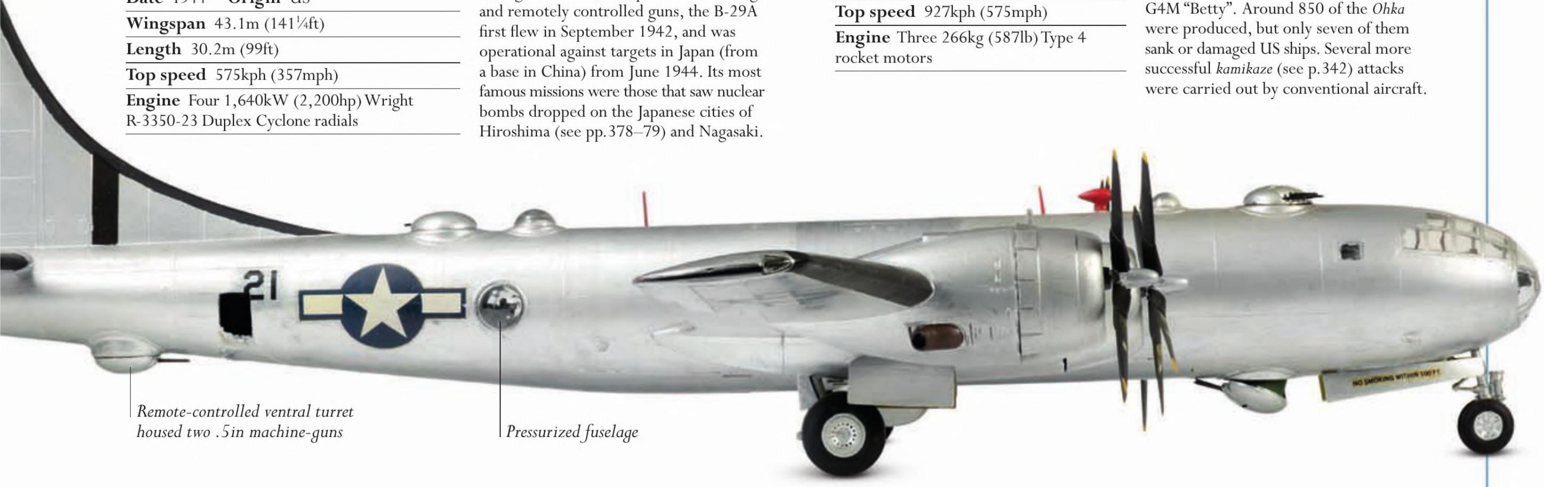
Date 1944 **Origin** Japan
Wingspan 5.12m (16¾ft)
Length 6.06m (19¾ft)
Top speed 927kph (575mph)
Engine Three 266kg (587lb) Type 4 rocket motors

The *Ohka* was a manned flying bomb powered by three solid-fuel rocket motors. It was intended to be used against warships, and was carried to its target below a mother-aircraft – usually a Mitsubishi G4M "Betty". Around 850 of the *Ohka* were produced, but only seven of them sank or damaged US ships. Several more successful *kamikaze* (see p.342) attacks were carried out by conventional aircraft.

▼ BOEING B-29A SUPERFORTRESS

Date 1944 **Origin** US
Wingspan 43.1m (141¼ft)
Length 30.2m (99ft)
Top speed 575kph (357mph)
Engine Four 1,640kW (2,200hp) Wright R-3350-23 Duplex Cyclone radials

The largest and most capable of the Allies' strategic bombers, with pressurized fuselage and remotely controlled guns, the B-29A first flew in September 1942, and was operational against targets in Japan (from a base in China) from June 1944. Its most famous missions were those that saw nuclear bombs dropped on the Japanese cities of Hiroshima (see pp.378–79) and Nagasaki.



Remote-controlled ventral turret housed two .5in machine-guns

Pressurized fuselage

WORLD WAR II LONG-RANGE HEAVY BOMBER

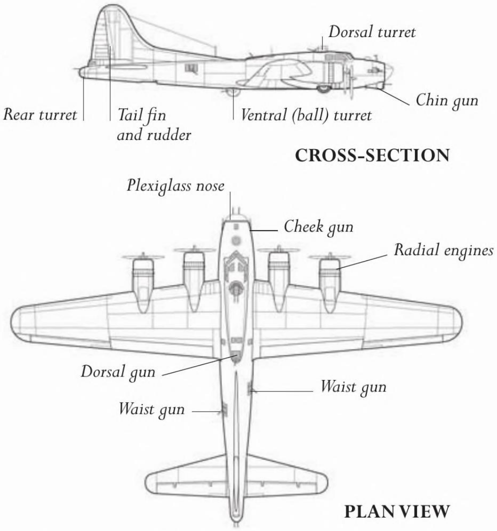
BOEING B-17 FLYING FORTRESS

Conceived in the 1930s, the B-17 epitomized a new type of bomber aircraft, able to carry heavy loads over long distances. Supplied to Great Britain by the US as part of the Lend Lease deal, it became one of the mainstays of the Allied bombing offensive in Europe.

The B-17C was the first version to go to war, in July 1941, but only with the arrival of the B-17E two months later did the aircraft begin to make its mark. Its reputation was assured when the definitive B-17G was introduced in October 1943.

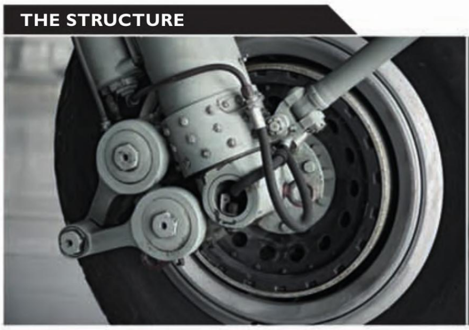
For short-range missions, a B-17G could carry a 3,600kg (8,000lb) bomb load, but that was reduced to 2,700kg (6,000lb) when the aircraft was fuelled for 3,200km (2,000 miles). The top speed was 462kph (287mph), although in mass formation the planes did not exceed 290kph (180mph).

Flying by day made B-17s vulnerable, in spite of their heavy armament, but losses fell after long-range fighters were developed to escort them. In all, 12,671 B-17s were built, and around 37 per cent of these were lost.



▲ **BOMBER PROFILE**
The B-17 had a wingspan of 31.62m (103¾ft) and measured 22.66m (74⅓ft) from nose to tail. The huge tail fin gave the aircraft a distinctive profile.

THE STRUCTURE



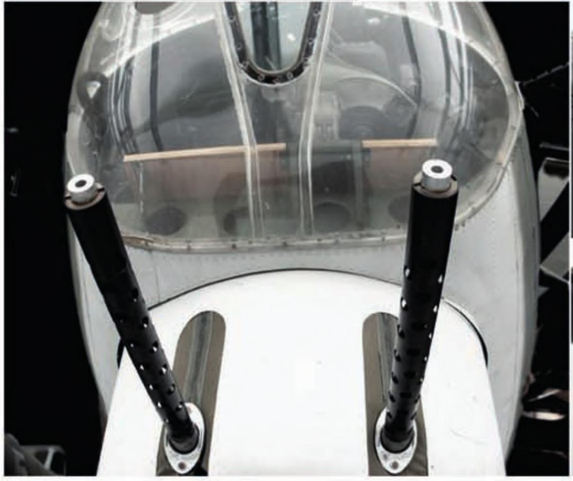
▲ **ROBUST UNDERCARRIAGE**
To support a loaded weight of almost 25.5 tonnes (25 tons), the undercarriage struts had to be robust, with massive hydraulic shock-absorbers.

▲ **ALUMINIUM SKIN**
The wings and fuselage were clad with light-gauge aluminium, riveted to the frames beneath.

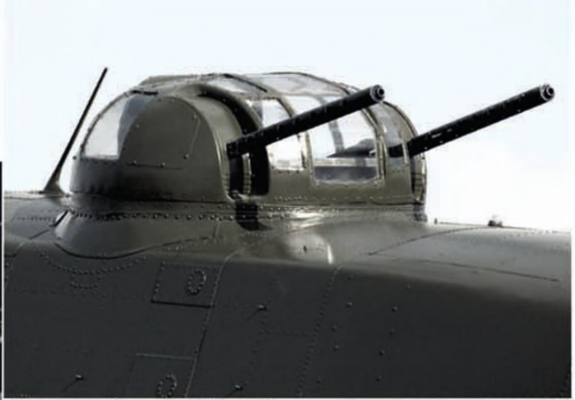
▲ **WING ROOT**
Construction was not sophisticated; no effort was made to improve the airflow by counter-sinking the fastenings.

▶ **RADIAL ENGINE**
The B-17's four 1,200hp Wright radial engines were equipped with turbo-superchargers to improve high-altitude performance.

THE GUNS



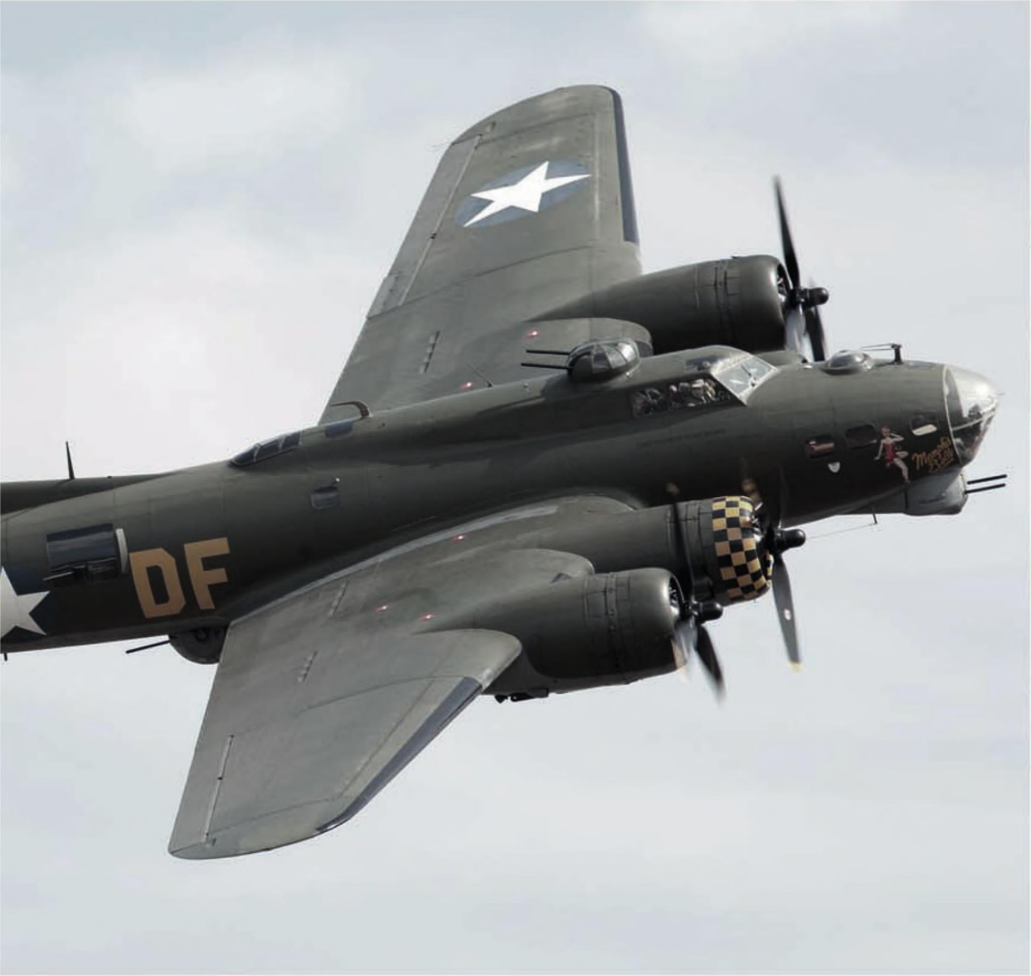
▲ AT THE NOSE
The bombardier had a clear view of the target through the plexiglass nose. He also operated the twin .5in Browning M2 machine-guns in the chin turret below, by remote control.

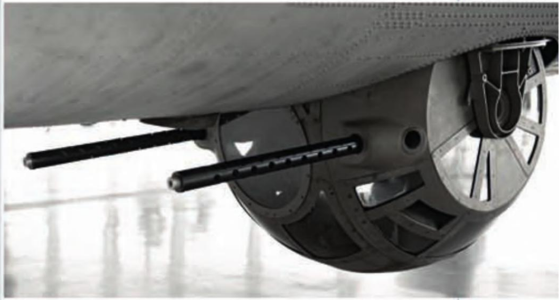


◄ DORSAL TURRET
The forward dorsal guns were mounted above the cockpit in a hydraulically powered turret with 360° traverse and 90° elevation; they were operated by the flight engineer.

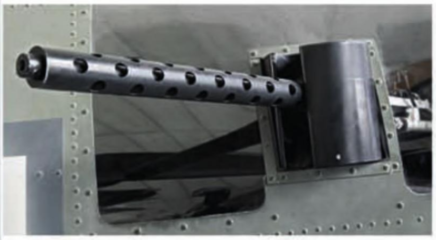
▲ CHIN GUN
A chin turret was added on the B-17G after research showed that the plane was vulnerable to head-on attacks.

▲ CHEEK GUN
Single flexibly mounted M2 machine-guns were mounted just aft of the bombardier's position; they were operated by the navigator.





▲ BALL TURRET
The F and G variants featured a ventral (ball) turret that was suspended on a gimbal from a tube attached to the fuselage ceiling.

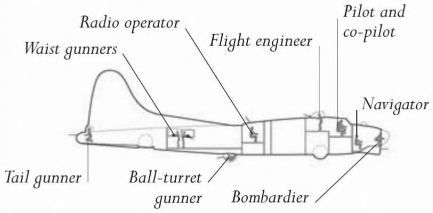


▲ WAIST GUN
Along the fuselage in staggered positions, port (aft) and starboard (forward), were single, flexibly mounted M2s, each with its own gunner.

◄ A MIGHTY FORTRESS
With a ten-man crew, the B-17 was cramped, but its crews set great store by its ability to get them home even when badly damaged.

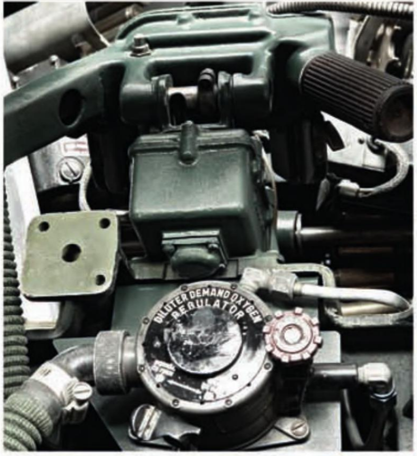
INSIDE THE B-17

Much of the B-17's slim fuselage was taken up by the bomb bay. The pilot and co-pilot in the cockpit, and the flight engineer behind them, were relatively comfortable, as were the radio operator, bombardier, and navigator, though the latter two had to squirm into their positions in the nose via a narrow opening. The tail and ball-turret gunners, however, had to be contortionists to reach their places. They and the waist gunners wore electrically-heated suits.


Radio operator
Pilot and co-pilot
Waist gunners
Flight engineer
Navigator
Tail gunner
Ball-turret gunner
Bombardier

CROSS-SECTION

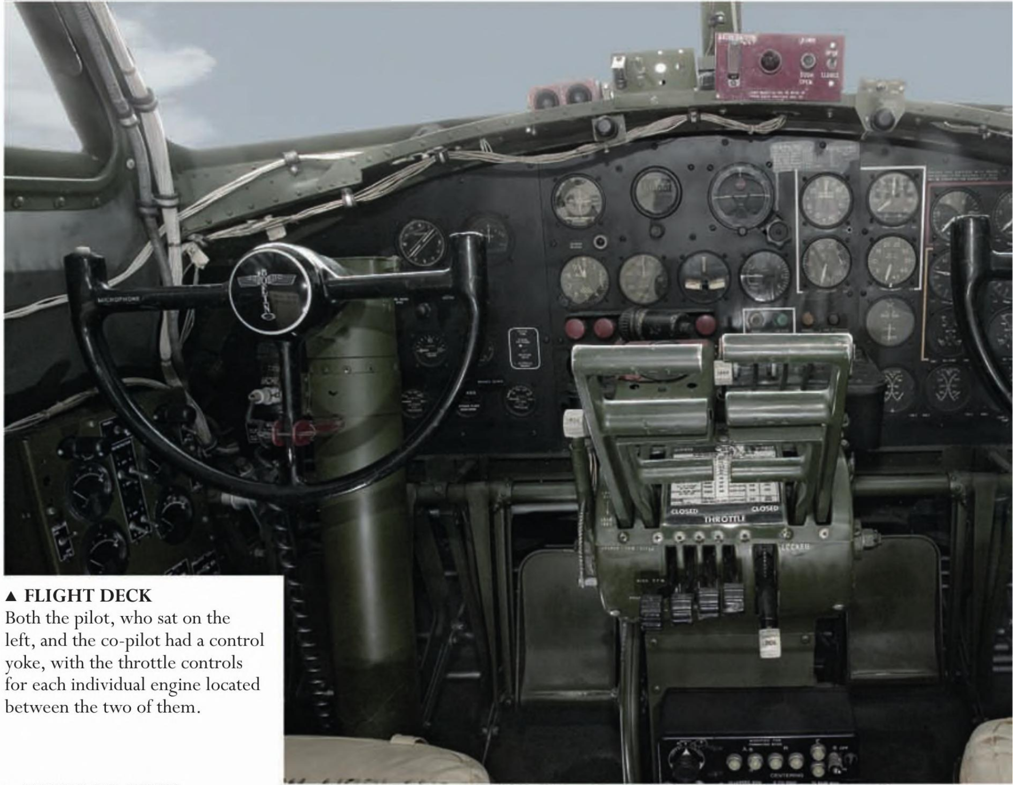
THE OXYGEN SUPPLY


DILUTER DEMAND OXYGEN REGULATOR

▲ **OXYGEN REGULATOR**
Each crewman was supplied with oxygen from a central source. He used a portable bottle (*below*) if he needed to move around the aircraft.

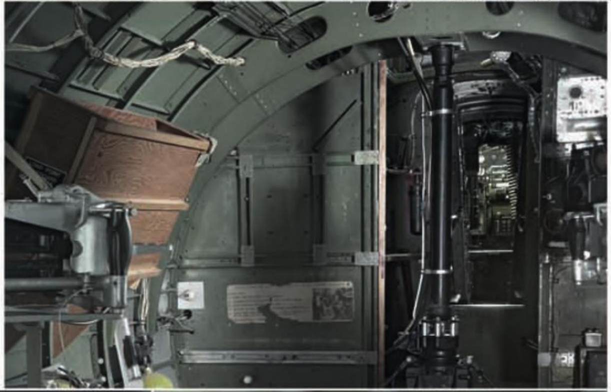
▲ **CENTRAL SUPPLY**
There were 18 large oxygen cylinders in the lower fuselage. Oxygen was vital at the B-17's operating height of over 7,600m (25,000ft).

FLIGHT DECK AND FUSELAGE


CLOSED
THROTTLE
CLOSED
LOCKED

▲ **FLIGHT DECK**
Both the pilot, who sat on the left, and the co-pilot had a control yoke, with the throttle controls for each individual engine located between the two of them.

▶ **FORWARD VIEW**
Looking towards the radio operator's position from the starboard waist gun, the fuselage ribs are clearly visible. The black column supports the ball turret below the fuselage.

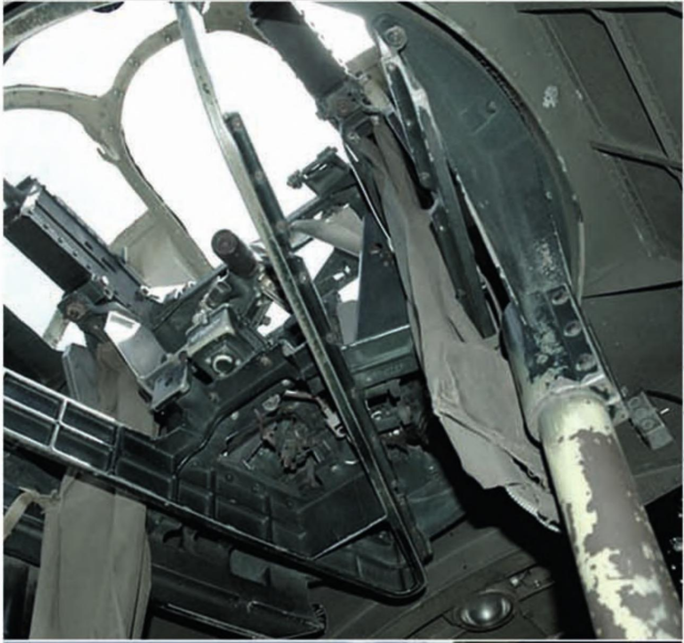


▼ **PITCH CONTROLS**
The propellers' pitch and the throttle settings had to be adjusted to regulate the aircraft's airspeed, and this required the attention of both men.

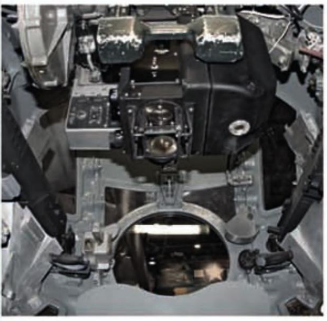
▲ **CONTROL CABLES**
Cables running from the flight deck through the fuselage to the control surfaces activated the rudder, ailerons, and elevators.

DO NOT REMOVE FROM AI

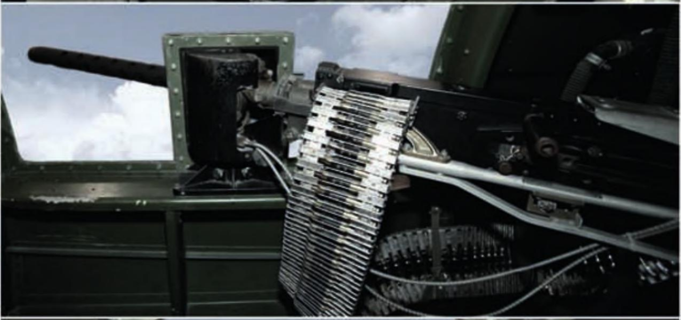
THE GUNS AND BOMBS



◄ TOP GUNS
There were three dorsal machine-guns. In addition to the pair in the powered turret above the cockpit, the radio operator had a single .5in M2 gun in a flexible mount above his own position.

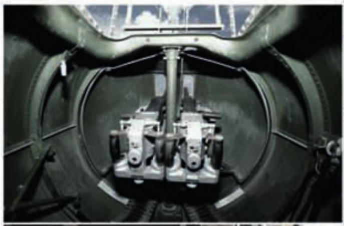


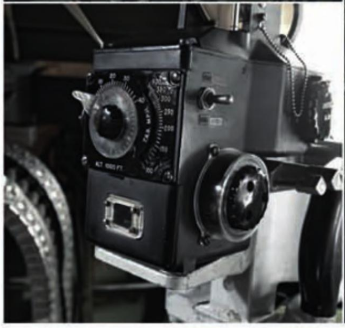
▲ BALL TURRET
The gunner for the ball turret climbed into position after take off. Lack of space forced him to sit with his knees against his chest. In an emergency, he donned a parachute only after clambering back into the fuselage.



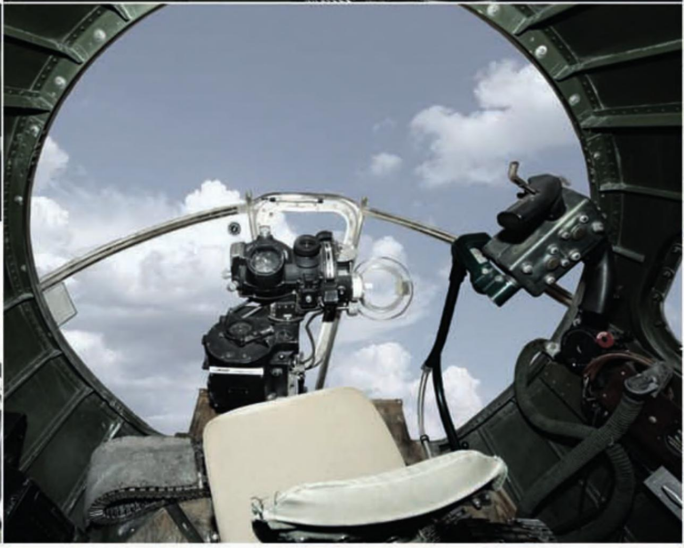
◄ WAIST GUN
The two single machine-gun positions in the waist were open to the elements until the E model was introduced. There was no recovery system for spent cartridge cases, which littered the floor.

▼ TAIL TURRET
Like the ball-turret gunner, the tail gunner had very limited space. He had to operate his paired M2 machine-guns from a kneeling position.

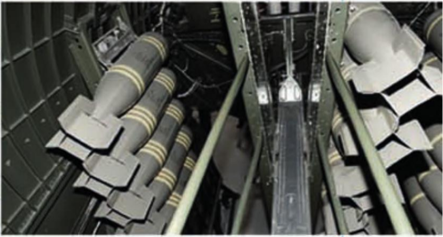




▲ GUN SIGHT
The waist guns had compensating sights that could be programmed with the aircraft's speed and altitude to give the "lead" required to hit a moving target.

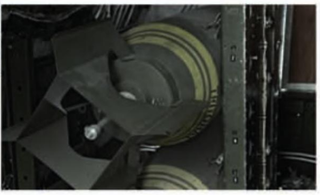


▲ NORDEN BOMB SIGHT
One of the most sophisticated pieces of equipment in the entire aircraft, the bomb sight was a predictive computer that allowed the bombardier to compensate for such factors as the aircraft's altitude and forward speed, and the type of bombs carried.



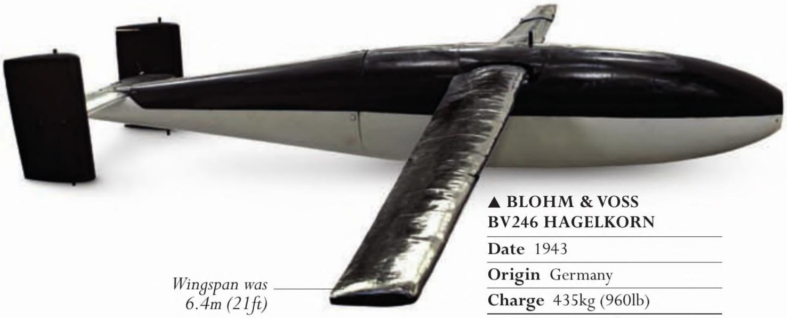
▲ BOMB BAY
From his position, the bombardier could see into the bomb bay, below and aft of the flight deck.

▼ BOMB LOAD
A typical load included high explosive bombs and mixed incendiary devices.



BOMBS AND MISSILES OF WORLD WAR II

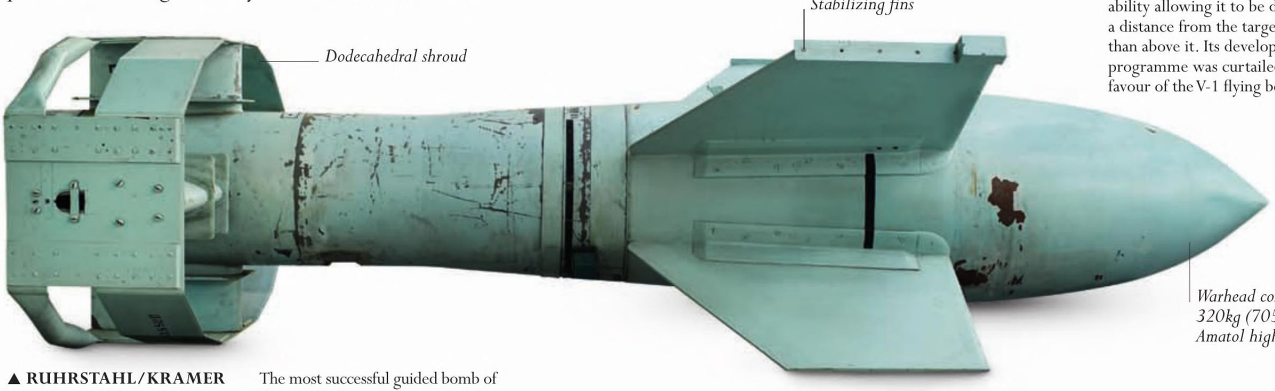
Initially, aerial bombs were simple iron cylinders filled with explosives and fused to detonate on impact; sometimes they had rudimentary fins, but were still only suitable for hitting areas rather than specific targets. Aerodynamic casings and more effective fins made flight paths more predictable, but even the best bombs were far from accurate. As soon as appropriate technologies became available, bombs were fitted with guidance systems, some of them built-in, others requiring a controlling hand in the launch aircraft. By 1944, following much experimentation with rocketry, the first generation of "surface-to-surface" missiles appeared (i.e. launched from the ground to strike ground targets), and promised to change the very nature of the war in the air.


Wingspan was 6.4m (21ft)

▲ BLOHM & VOSS BV246 HAGELKORN

Date 1943
Origin Germany
Charge 435kg (960lb)
Length 3.5m (11½ft)

The *Hagelkorn* ("Hailstone") glide-bomb was an unpowered air-to-surface missile, its gliding ability allowing it to be dropped at a distance from the target rather than above it. Its development programme was curtailed in favour of the V-1 flying bomb.


Dodecahedral shroud
Stabilizing fins
Warhead contained 320kg (705lb) of Amatol high explosive

▲ RUHRSTAHL/KRAMER X-1 "FRITZ X"

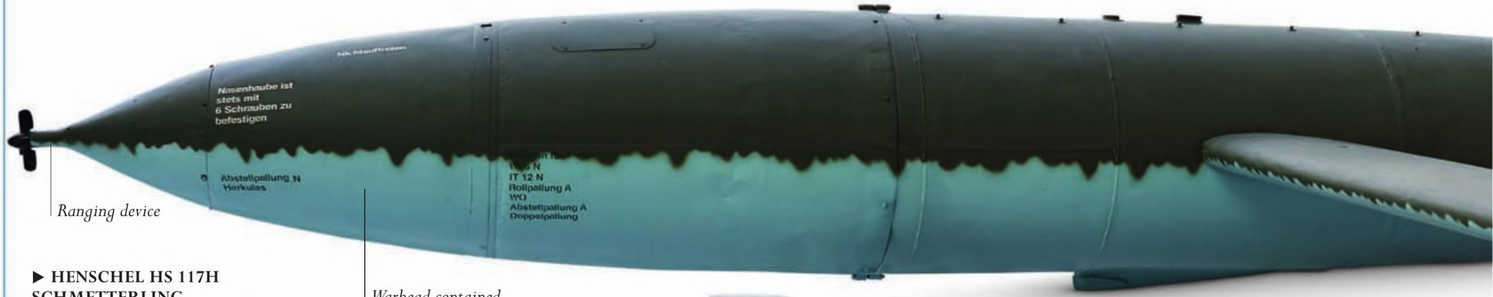
Date 1943
Origin Germany
Charge 320kg (705lb)
Length 3.3m (11ft)

The most successful guided bomb of the war, the "Fritz X" was steered to its target by an operator aboard the launching aircraft. It was a marked success, with the *Luftwaffe*'s specialist unit, *Kampfgeschwader* 100, sinking the British ship HMS *Warspite* at Salerno.

▼ FIESLER FI103 (V1)

Date 1944
Origin Germany
Charge 830kg (1,830lb)
Length 8.32m (27⅓ft)

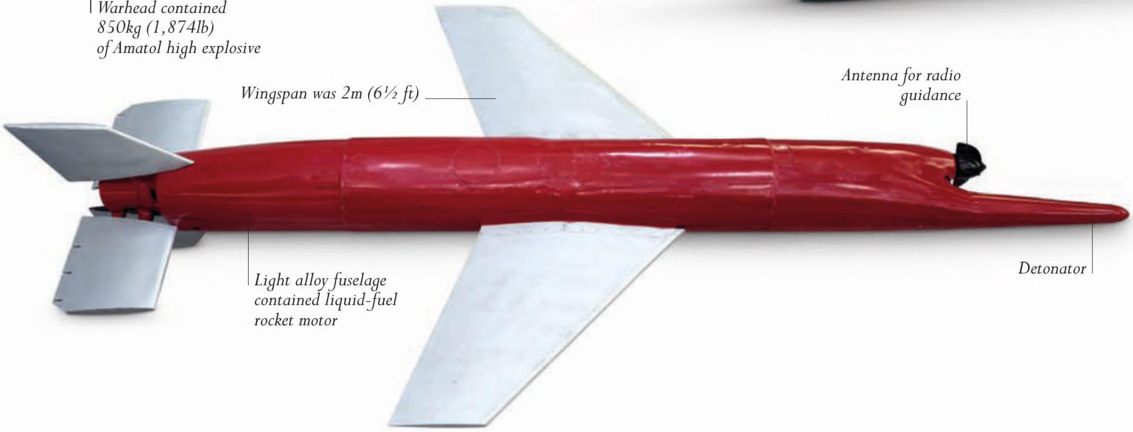
The first long-range surface-to-surface missile, the FI103 was launched from a ramp by a steam catapult, and was powered by a simple pulse-jet motor. It was deployed from 13 June 1944 against targets in the UK and later against Antwerp.

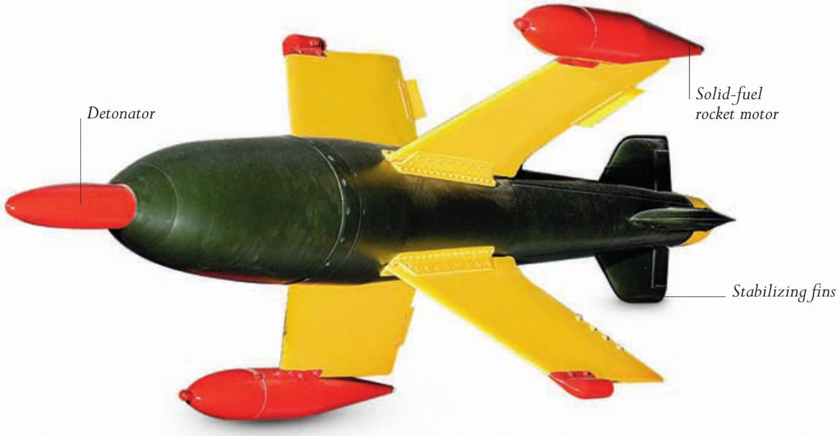

Nasenhaube ist stets mit 6 Schrauben zu befestigen
Abstellpallung N Herkules
IT 12 N
Rollpallung A
WO
Abstellpallung A
Doppelpallung
Ranging device
Warhead contained 850kg (1,874lb) of Amatol high explosive

▶ HENSCHEL HS 117H SCHMETTERLING

Date 1944
Origin Germany
Charge 25kg (55lb)
Length 4.2m (13¾in)

The Henschel *Schmetterling* (Butterfly) was a surface-to-air and air-to-air radio-guided anti-aircraft missile. Its latter form, the HS 117H, dispensed with the rocket boosters fitted to the surface-to-air missile variant. Its maximum range was 10km (6¼miles), and it travelled at 940kph (585mph).


Wingspan was 2m (6½ ft)
Antenna for radio guidance
Light alloy fuselage contained liquid-fuel rocket motor
Detonator


Detonator
Solid-fuel rocket motor
Stabilizing fins

▲ RUHRSTAHL X-4 AAM

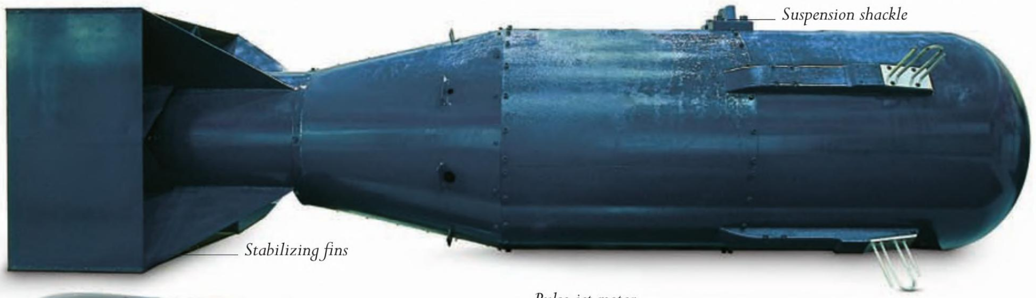
Date	1944
Origin	Germany
Charge	20kg (44lb)
Length	2m (6½ft)

The X-4 air-to-air (i.e. aircraft-to-aircraft) missile was developed as a "stand-off" weapon, to be delivered from outside the range of the target aircraft's guns. Powered by a liquid-fuel rocket, it had a range of up to 4km (2½ miles), and flew at over 1,100kph (683½mph). It was guided by a wire connecting it to its mother-aircraft.

▼ ATOMIC BOMB MK I "LITTLE BOY"

Date	1945
Origin	US
Charge	15,000 tons TNT equivalent
Length	3m (12¾ft)

"Little Boy" was the codename given to the first nuclear device used in war. The US Army Air Forces dropped it over Hiroshima (see pp.378–79), in Japan, from the B-29 Superfortress "Enola Gay" bomber aircraft on 6 August 1945, to devastating effect.

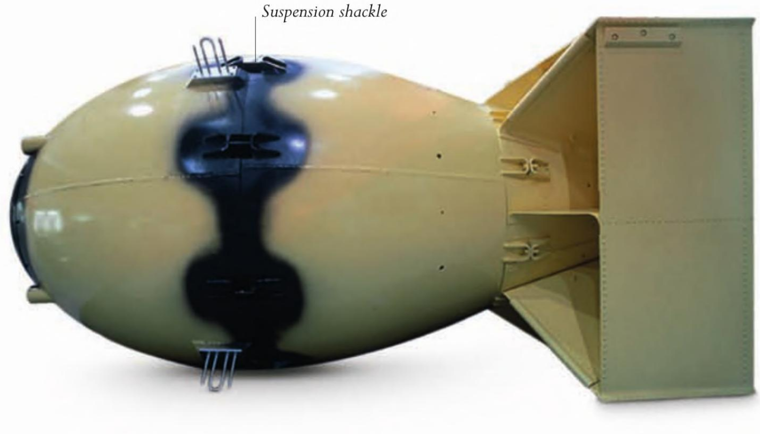

Suspension shackle
Stabilizing fins

Pulse-jet motor
Wingspan was 5.4m (17¾ft)

▶ ATOMIC BOMB MK II "FAT MAN"

Date	1945
Origin	US
Charge	21,000 tons TNT equivalent
Length	3.3m (10¾ft)

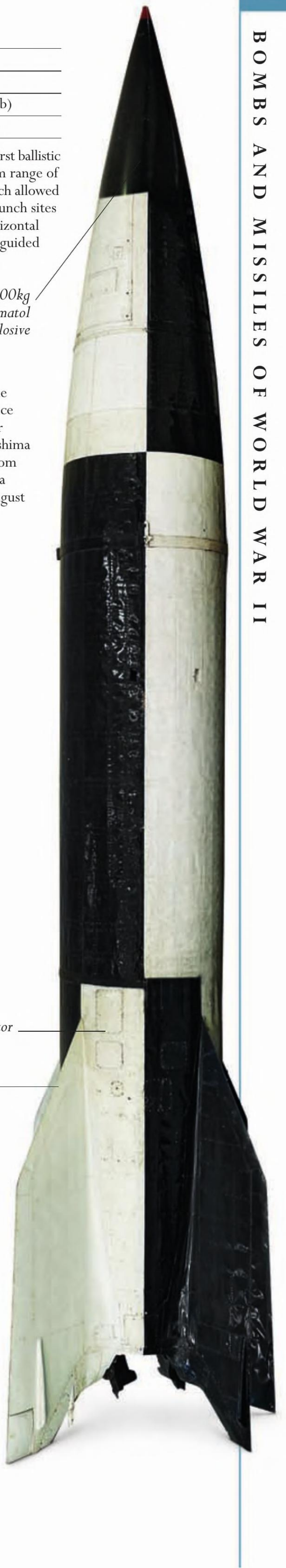
"Fat Man" was the second nuclear device dropped by the US Army Air Forces on Japan, this time on the city of Nagasaki, on 9 August 1945. It was a completely different design to that of "Little Boy", using plutonium in place of uranium.


Suspension shackle

▶ A4 (V2)

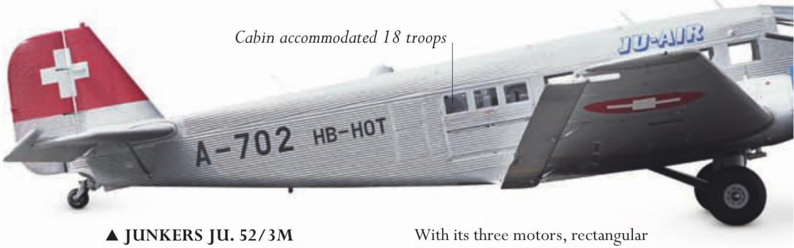
Date	1944
Origin	Germany
Charge	975kg (2,150lb)
Length	14.05m (46ft)

The A4 was the world's first ballistic missile, with a maximum range of 330km (205 miles), which allowed it to hit London from launch sites in the Netherlands. Horizontal and vertical gyroscopes guided the rocket.


Warhead contained 1,000kg (2,205lb) of Amatol high explosive
Rocket motor
Stabilizing fins

TRANSPORT, RECONNAISSANCE, AND LIAISON AIRCRAFT

The first military transport aircraft were commercial aeroplanes developed during the interwar period, but purpose-built designs better suited to military operations soon began to appear. Specialist reconnaissance aircraft were developed, too: some, especially those designed to undertake maritime operations, doubled up in the attack role, while others dispensed with armament completely in the interest of being able to fly higher and faster than any armed interceptor the enemy could send against them – a principle that has held into the modern era. Light aircraft were also pressed into military service to operate both in and away from the combat zone.

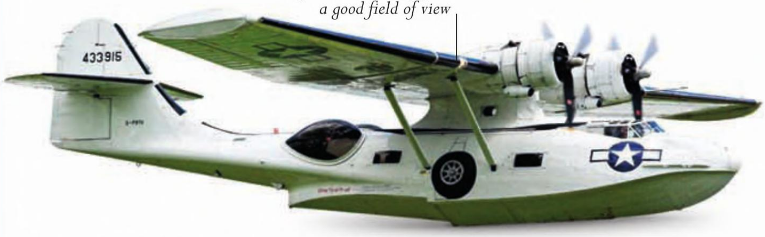


Cabin accommodated 18 troops

▲ JUNKERS JU. 52/3M

Launched 1932 **Origin** Germany
Wingspan 29.25m (95¾ft)
Length 18.9m (62ft)
Top speed 265kph (165mph)
Engine Three 533kW (715hp) BMW 132 radials

With its three motors, rectangular fuselage and corrugated Duralumin skin, the Ju. 52 was instantly recognizable. Originally produced as a 17-seater airliner, it was taken up for military service in 1935. In combat zones, losses were invariably high; 280 were lost in May 1940 during the invasion of the Netherlands.

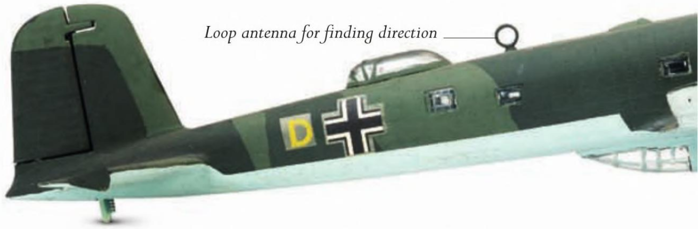


High-mounted wing gave a good field of view

▲ CONSOLIDATED PBY CATALINA

Launched 1936 **Origin** US
Wingspan 31.7m (104ft)
Length 19.5m (64ft)
Top speed 315kph (196mph)
Engine Two 895kW (1,200hp) Pratt & Whitney R-1830-92 Twin Wasp radials

Designed as a "patrol bomber", the Catalina is the most successful flying boat ever produced; many are still in use, chiefly to fight wildfires, 75 years after it was introduced.

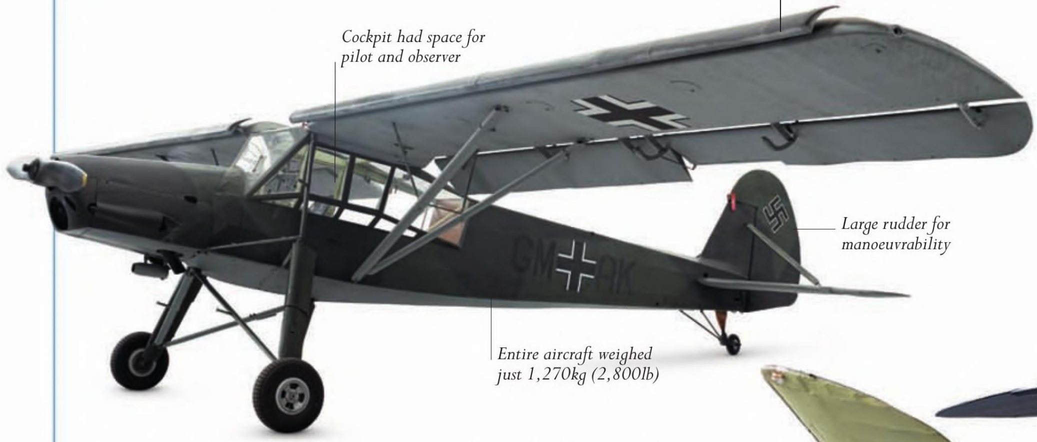


Loop antenna for finding direction

▲ FOCKE-WULF FW. 200 CONDOR

Launched 1937 **Origin** Germany
Wingspan 32.85m (107¾ft)
Length 23.45m (77ft)
Top speed 360kph (225mph)
Engine Four 895kW (1,200hp) BMW 323R radials

The Condor was built for Lufthansa as a long-range airliner, but was adapted for military service in mid-1939. It was not robust enough to be a success as a military transport craft, but was better suited to maritime reconnaissance and for attacking shipping. A total of 276 were built, most of which were lost during the war.



Flaps extended the full length of the wings

Cockpit had space for pilot and observer

Large rudder for manoeuvrability

Entire aircraft weighed just 1,270kg (2,800lb)

▲ FIESELER FI.156 STORCH

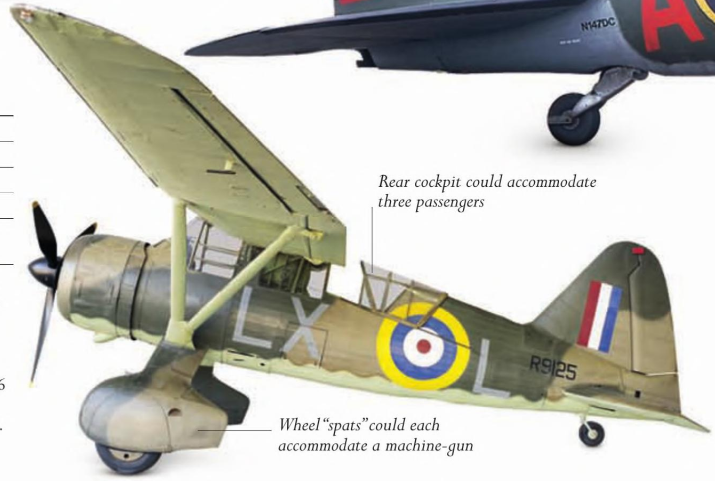
Launched 1937 **Origin** Germany
Wingspan 14.3m (46¾ft)
Length 9.9m (32½ft)
Top speed 175kph (110mph)
Engine 177kW (240hp) Argus As 10 V8

The *Storch* (Stork) was designed as an army liaison aircraft. Unusually for a land-based aircraft, it had wings that could be folded back along its fuselage. Its approach speed was so low that in a headwind it appeared to land almost vertically.

▶ WESTLAND LYSANDER

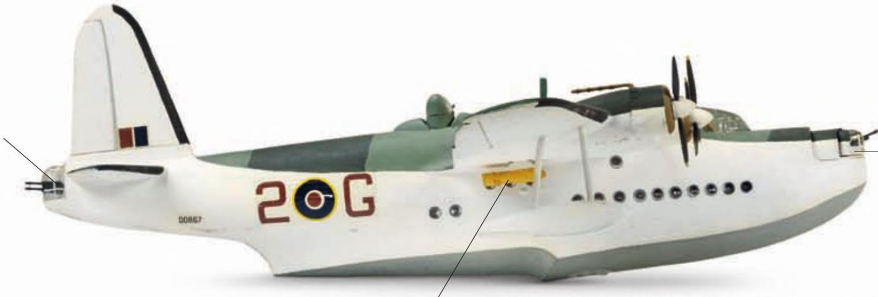
Launched 1938 **Origin** UK
Wingspan 15.25m (50ft)
Length 9.3m (30½ft)
Top speed 340kph (211mph)
Engine 649kW (870hp) Bristol Mercury XX radial

The Lysander was used for World War II army operations, perhaps most famously by the British Royal Air Force's 138 (Special Duties) and 161 Squadrons, which employed it to insert and recover agents in enemy-occupied territory. 1786 were built in total, all of which were withdrawn from service at the war's end.



Rear cockpit could accommodate three passengers

Wheel "spats" could each accommodate a machine-gun



Four Browning machine-guns in rear turret

Nose turret housed two Browning machine-guns

Under-wing racks could accommodate bombs, depth-charges, or torpedoes

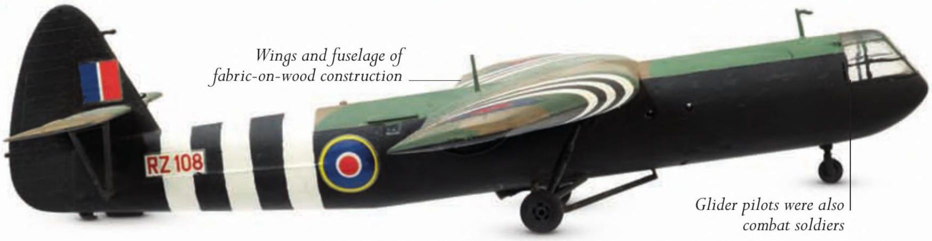
▲ SHORT S.25 SUNDERLAND

Launched 1938 **Origin** UK
Wingspan 34.4m (112¾ft)
Length 26m (85⅓ft)
Top Speed 335kph (210mph)
Engine Four 794kW (1,065hp) Bristol Pegasus XVII radials

Developed from the successful Empire airliner, the Sunderland was the British Royal Air Force's principal patrol/reconnaissance bomber flying boat for 21 years. It was unusual in having "bomb rooms" where selected ordnance could be loaded on racks, which were then winched out under the wings and opened to unload the bombs.

Two 13mm machine-guns

Remote-controlled 20mm cannon



Wings and fuselage of fabric-on-wood construction

Glider pilots were also combat soldiers

▲ AIRSPEED HORSA GLIDER

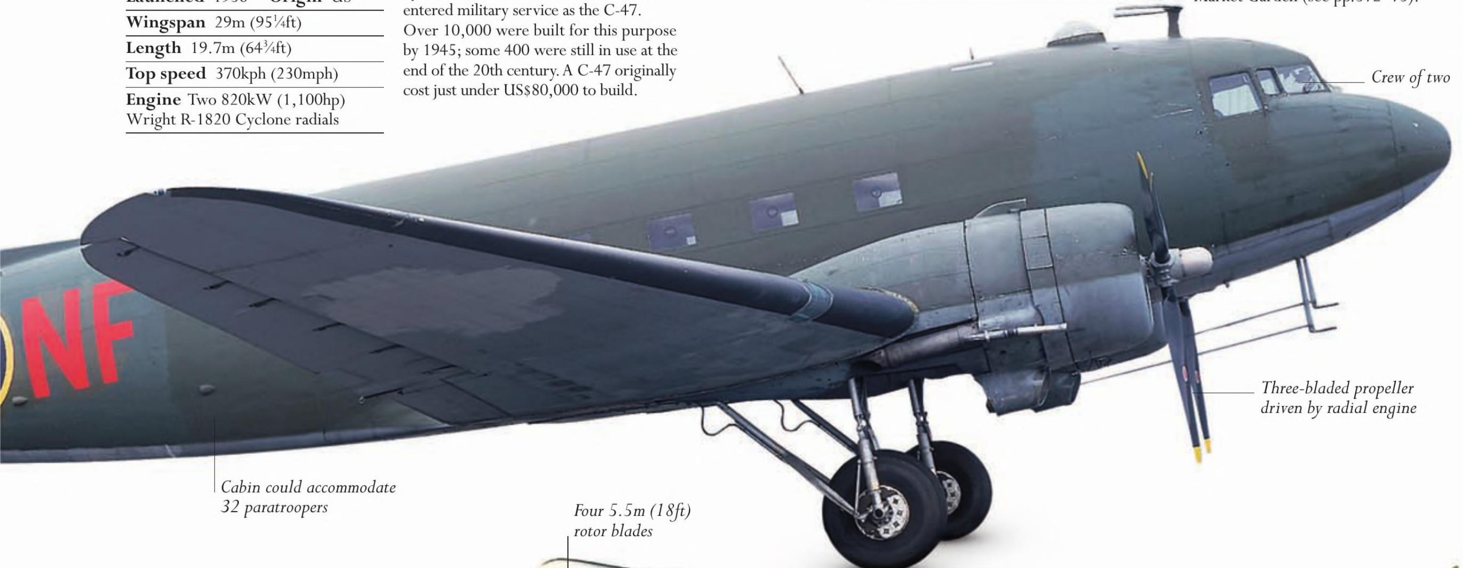
Launched 1941 **Origin** UK
Wingspan 26.8m (88ft)
Length 20.4m (67ft)
Top speed 160kph (100mph)
Engine None

The *Luftwaffe* used gliders during the invasion of Belgium and France in 1940, and the British soon followed. The Horsa was larger than the German DFS 30, and could carry 25 troops. Some 4,000 were built, over 1,200 of which were expended in Operation Market Garden (see pp.372–73).

▼ DOUGLAS C-47 SKYTRAIN

Launched 1936 **Origin** US
Wingspan 29m (95¼ft)
Length 19.7m (64¾ft)
Top speed 370kph (230mph)
Engine Two 820kW (1,100hp) Wright R-1820 Cyclone radials

Introduced as a commercial airliner by American Airlines, the DC-3 soon entered military service as the C-47. Over 10,000 were built for this purpose by 1945; some 400 were still in use at the end of the 20th century. A C-47 originally cost just under US$80,000 to build.



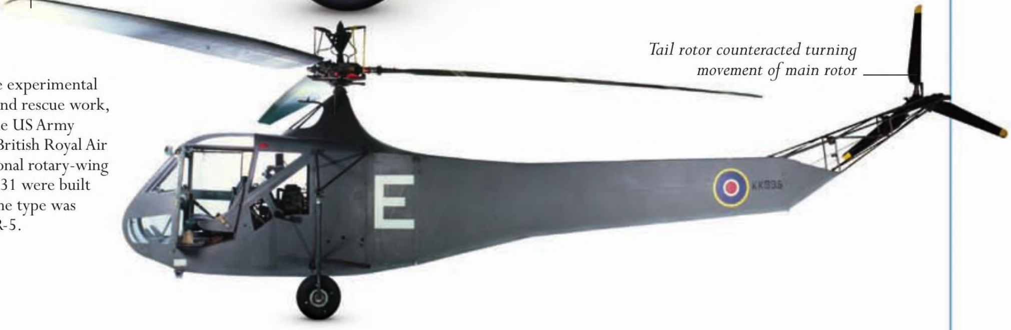
Crew of two

Three-bladed propeller driven by radial engine

Cabin could accommodate 32 paratroopers

Four 5.5m (18ft) rotor blades

Tail rotor counteracted turning movement of main rotor



▶ SIKORSKY R-4 HOVERFLY

Launched 1943 **Origin** US
Rotor diameter 11.5m (37¾ft)
Length 10.2m (33½ft)
Top speed 120kph (75mph)
Engine 149kW (200hp) Warner R-550 radial

Developed from the experimental VS-300 for liaison and rescue work, the Hoverfly was the US Army Air Forces and the British Royal Air Force's first operational rotary-wing aircraft. A total of 131 were built up to 1944, when the type was superseded by the R-5.

COMMUNICATIONS AND CODE-BREAKING EQUIPMENT OF WORLD WAR II

Between World War I and World War II great strides were made in both wired and wireless communications technology, the latter reaching a point at which it was possible to build reliable transmitter/receiver sets (transceivers) that would fit into a small suitcase. By 1939, mechanical calculators were commonplace in the business world, and the technology they employed was increasingly used to mechanize the encoding of messages, making them very difficult to decipher if intercepted. During World War II, these two apparently disparate disciplines joined forces to create the first electromechanical (and later electronic) computers, which were developed specifically as aids to code-breaking.

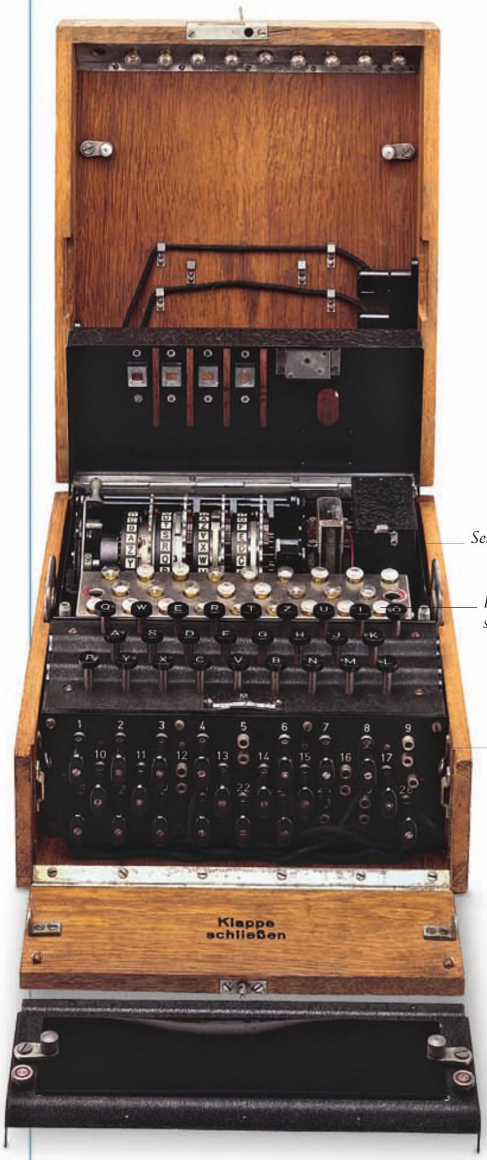
▼ **ENIGMA**

Date 1926–1950s

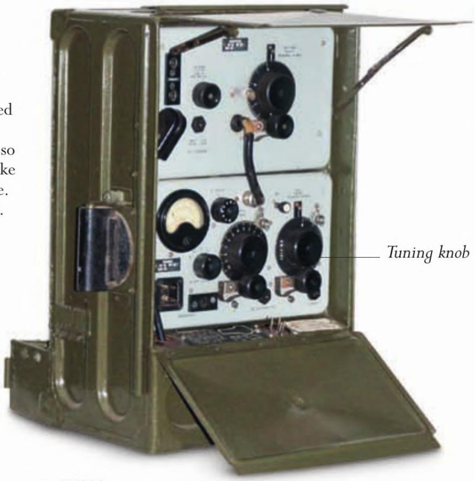
Origin Germany

Type Encoding/decoding device

The operator turned Enigma's rotors to a random setting and typed the message to be encoded using the keys below – each keystroke advancing the rotors so that repeating the same keystroke gave a different result each time. Decoding reversed this process.



Setting rotors
Illuminated indicators showed encoded character
Input keyboard
Klappe schließen



Tuning knob

▲ **WS18**

Date 1939

Origin UK

Type Radio transceiver

Described as being "for short range telephony in forward areas", the Wireless Set 18 had an effective transmission range of 8km (5 miles). It was issued in 1939, and was the first "man-pack" radio transceiver put into series production for the British Army.

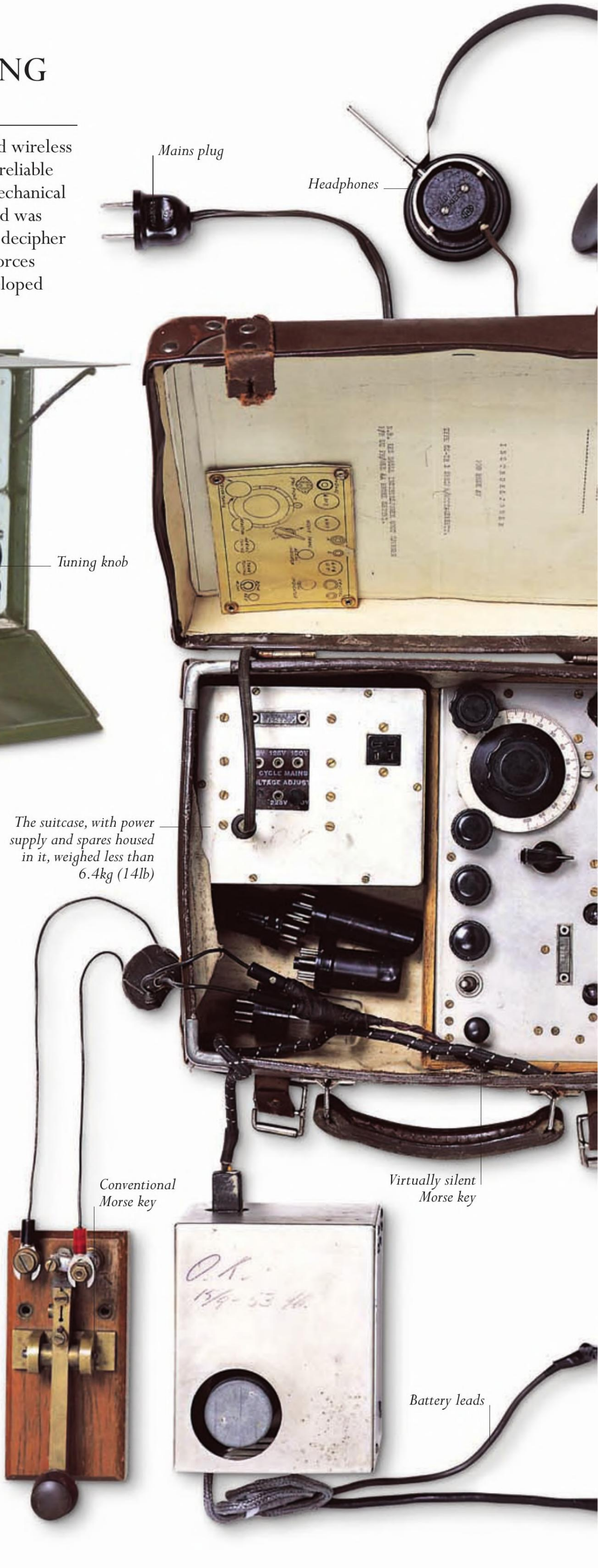
▶ **PARASET SUITCASE RADIO TRANSCEIVER**

Date 1940

Origin UK

Type Radio transceiver

The first miniature radio transceiver for clandestine use, the Whaddon Mk VII Paraset was the absolute minimum needed to set up two-way communication over distances of up to 800km (500 miles). It included a built-in Morse key that was almost silent in operation.



Mains plug
Headphones
The suitcase, with power supply and spares housed in it, weighed less than 6.4kg (14lb)
Conventional Morse key
Virtually silent Morse key
Battery leads

O. Ried Olsen.
Spare valve
Crystal assembly

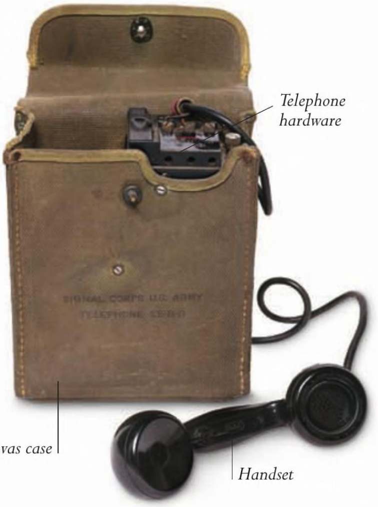
▶ TYPE EE-8-B US ARMY FIELD TELEPHONE

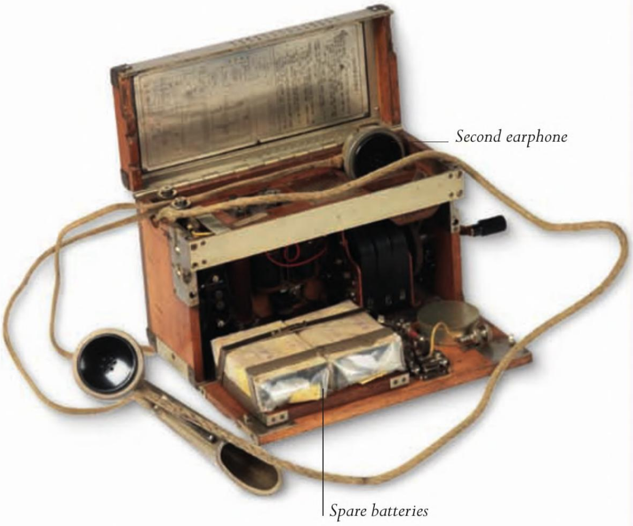
Date 1944

Origin US

Type Field telephone set

For security reasons, battlefield communication during the war, especially between rear-echelon command posts and front-line units, was still carried out by means of land lines rather than by radio wherever possible. This was to avoid the need for time-consuming encoding and decoding.


Telephone hardware
SIGNAL CORPS U.S. ARMY
TELEPHONE EE-8-B
Canvas case
Handset


Second earphone
Spare batteries

▲ FIELD TELEPHONE MODEL 92

Date 1932

Origin Japan

Type Field telephone set

Developed in peacetime by the Oki Electric Co, this field telephone was manufactured to a very high standard. The wooden case housed a generator, the headset, batteries, and spares. The Japanese employed the "ground return" system, which was both less secure and less reliable than using twin cables.

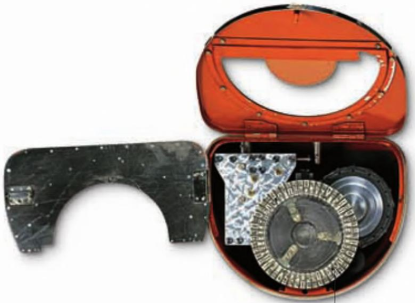
▶ KRYHA

Date 1920s–1940s

Origin Germany

Type Encoding/decoding device

Simpler in character than Enigma, Kryha was considerably less secure – a 1,135 characters-long test message was successfully broken by an American team within three hours. This purely mechanical device, however, had the advantage of being much smaller and lighter.


Twin dials showed input character and encoded equivalent

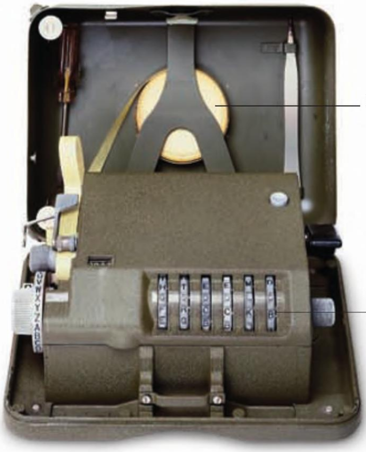
▼ TYPE A MK III SUITCASE RADIO TRANSCEIVER

Date 1944

Origin UK

Type Radio transceiver

This was the most widely used of the British "spy radios", and technically the best of them. It had a transmission range of over 800km (500 miles). Packed into a suitcase just 10cm (4in) deep, along with spares and accessories, it weighed only 4kg (8¾lb) in total.


Reel of paper tape
Initializing wheels

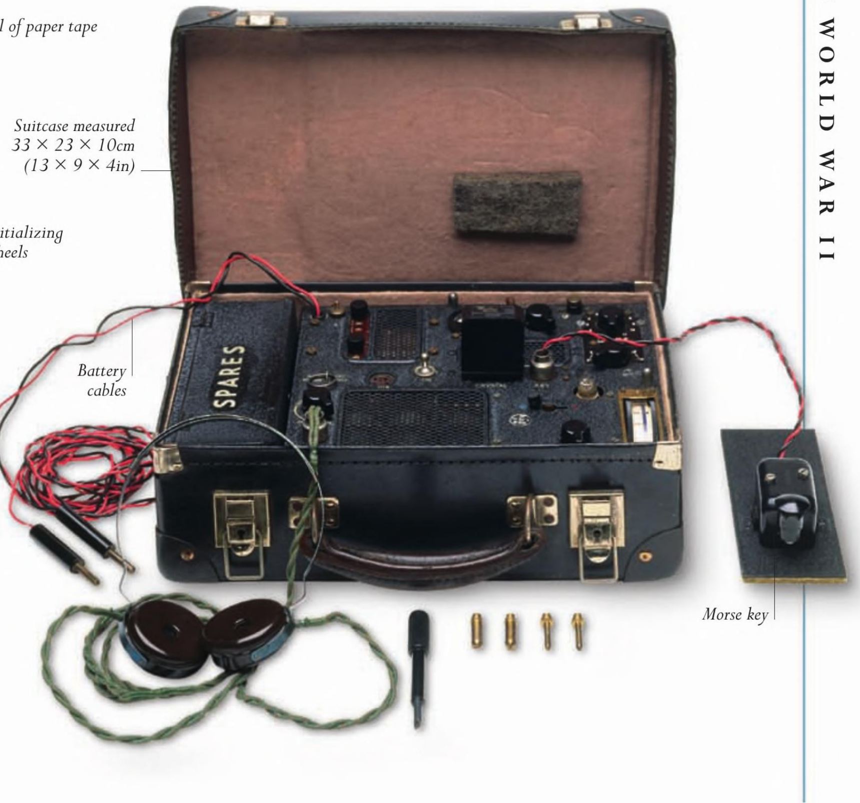
▲ M209B

Date 1940–1955

Origin US

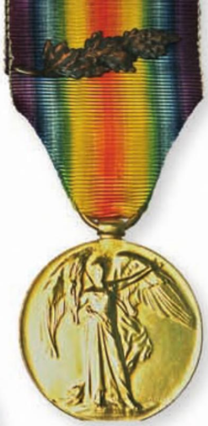
Type Encoding/decoding device

A purely mechanical encryption device, the M209 employed six alphabetic wheels to set up the initial key. The message was then entered one character at a time via the wheel on the left. The result was printed on paper tape, and the rotor settings advanced. Reversing the procedure permitted decoding. M209's output was decoded by German code-breakers by early 1943.


Suitcase measured 33 × 23 × 10cm (13 × 9 × 4in)
Battery cables
SPARES
Morse key

WORLD WAR ERA MEDALS

The World Wars saw countless acts of individual gallantry amid the mass actions of huge armies. Medals continued to be awarded for acts of exceptional bravery, and the sheer numbers of combatants meant that more were issued than ever before. Some medals that had been introduced previously took on a new significance during this period – notably Germany's "Blue Max" and the USA's Purple Heart.

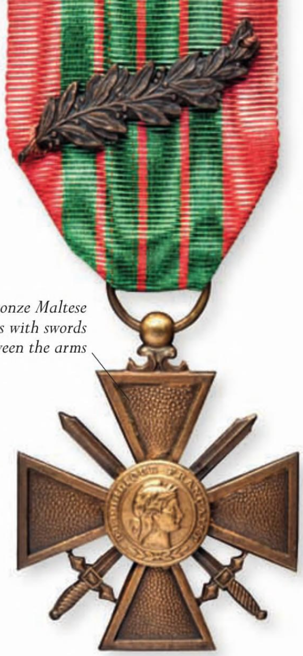


◀ WORLD WAR I VICTORY MEDAL

Date 1919

Origin US

The Victory Medal, as it was first known, was issued to US forces who had served in World War I and actions in Russia (1919–20).



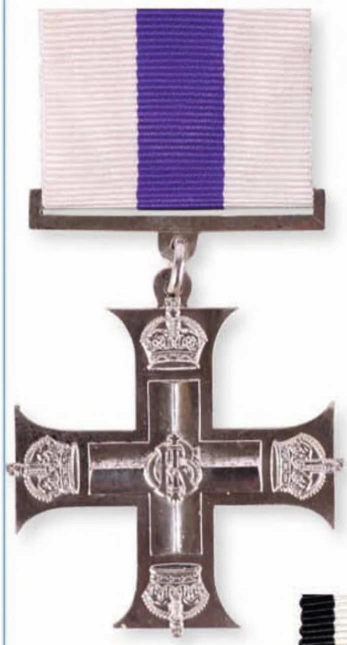
Bronze Maltese cross with swords between the arms

▶ CROIX DE GUERRE

Date 1915

Origin France

This medal was issued to individuals for bravery or other military virtues displayed on the battlefield during World War I, World War II, and in other campaigns not fought on French soil. The example pictured is a World War II medal.

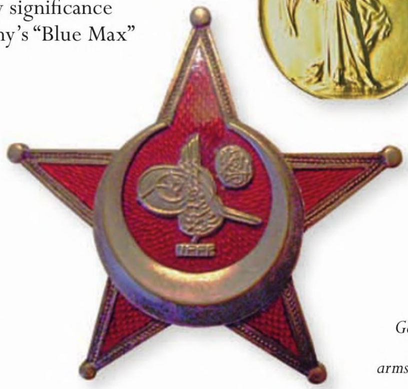


▲ MILITARY CROSS

Date 1914

Origin UK

Instituted in 1914 as a gallantry award for British army officers of a lower precedence than the Victoria Cross (see p.258) and the Distinguished Service Order, from 1993 onwards, the Military Cross has been open to all ranks for gallantry in land operations.



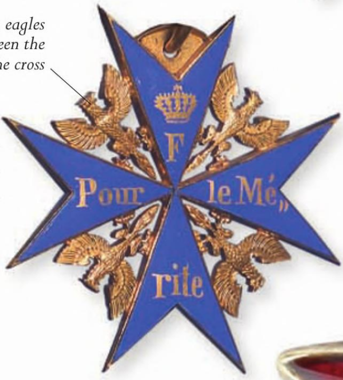
▲ OTTOMAN WAR MEDAL

Date 1915

Origin Turkey

Conflict World War I

Better known as the Gallipoli Star, this decoration was awarded for the duration of World War I to Turkish soldiers and their allies for gallantry in battle.



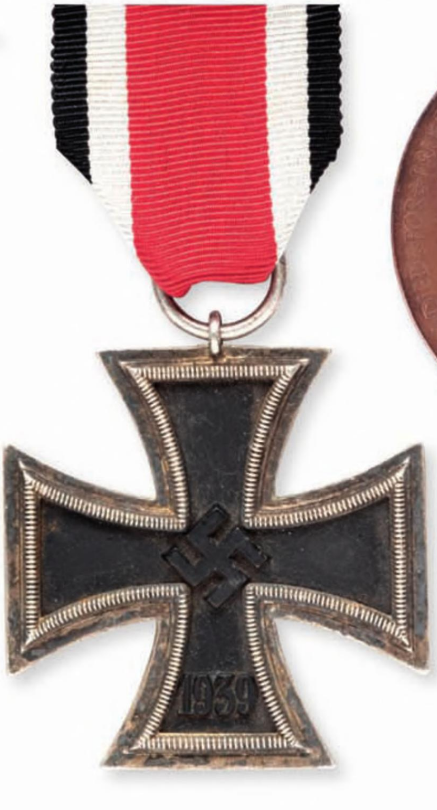
Golden eagles between the arms of the cross

▶ POUR LE MÉRITE (BLUE MAX)

Date 1740–1918

Origin Germany

This order was both a civillian and military honour until 1810, when it was restricted to serving military personnel. One of the first airmen to receive the award was World War I flying ace Max Immelmann; his fame led to the order becoming known as the Blue Max.

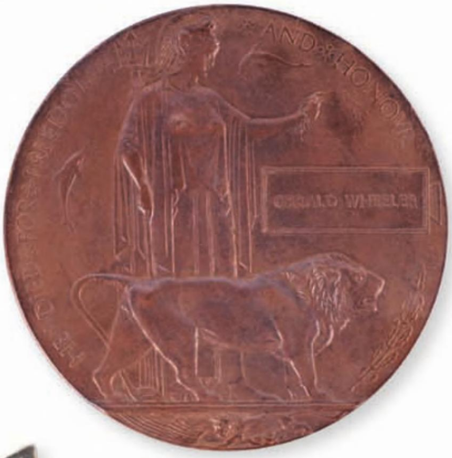


▶ IRON CROSS

Date 1914

Origin Germany

The Iron Cross was issued to all ranks, but only those who had already received a 2nd Class award could receive the 1st Class version. In World War I, around 4 million 2nd Class and 145,000 1st Class medals were awarded. The medal shown is a 1939 design with a central swastika.



▲ MEMORIAL PLAQUE

Date 1919

Origin UK

Conflict World War I

Awarded to the next-of-kin of those who lost their lives as a result of active service in World War I, this 120mm (4¾in) diameter bronze plaque bears the name of the dead serviceman.

▶ ORDER OF THE PATRIOTIC WAR

Date 1942

Origin Soviet Union

Conflict World War II

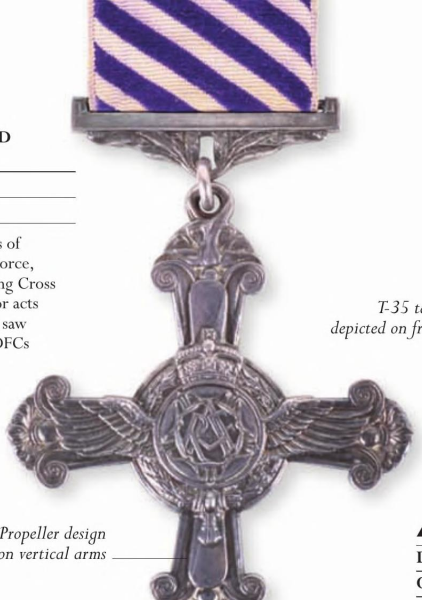
This silver-and-enamel medal was awarded to Soviet military personnel who fought on the Eastern Front, and to partisan fighters for personal bravery. The Order of the 1st Class was issued 344,000 times, while 1,028,000 2nd Class awards were made.

▶ DISTINGUISHED FLYING CROSS

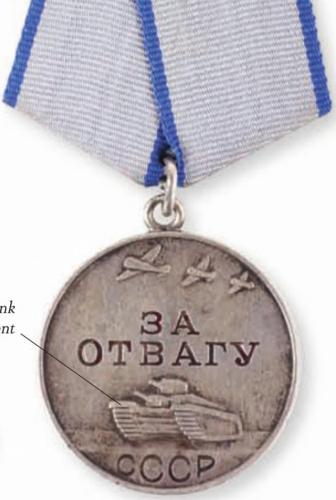
Date 1918

Origin UK

Introduced for officers of the British Royal Air Force, the Distinguished Flying Cross (DFC) was awarded for acts of valour. World War I saw approximately 1,100 DFCs issued, while 20,354 were awarded during World War II. The DFC was opened to all ranks in 1993.



Propeller design on vertical arms



T-35 tank depicted on front

▲ MEDAL FOR COURAGE

Date 1938

Origin Soviet Union

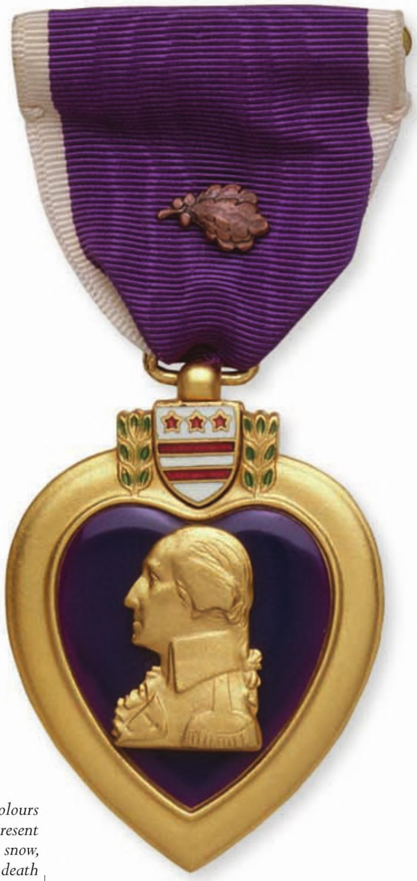
First introduced to recognize displays of courage in battle by military personnel in the defence of the Soviet Union, this medal continued to be awarded by Russia after the break-up of the USSR. Its recipients receive a monthly pension and travel free on Russian public transport.

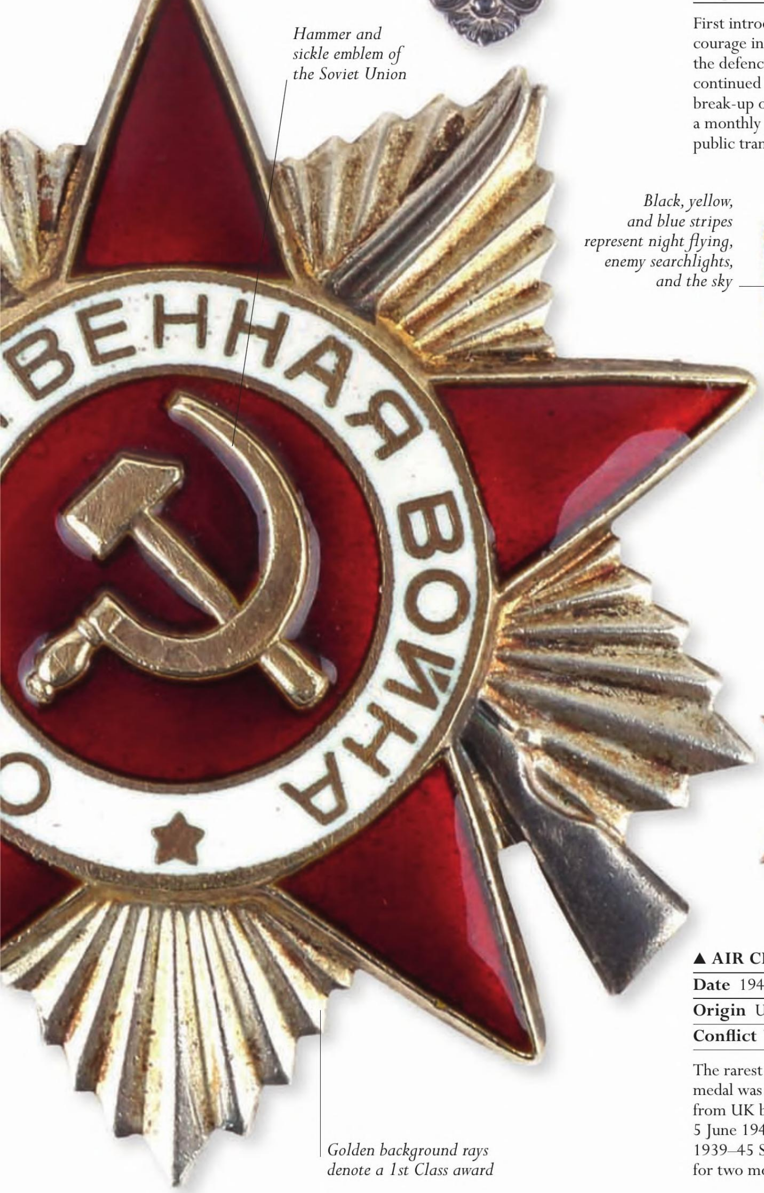
▼ PURPLE HEART

Date 1782

Origin US

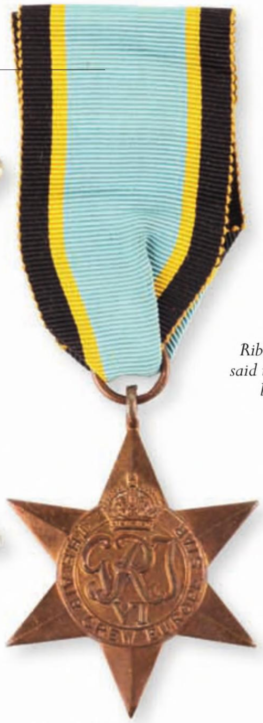
The original Purple Heart was instituted by George Washington in 1782 as the Badge of Military Merit, and was issued only to three Revolutionary War soldiers. The award was not proposed again until 1932. Approximately 1.9 million Purple Hearts have been issued since that date.





Hammer and sickle emblem of the Soviet Union

Golden background rays denote a 1st Class award



Black, yellow, and blue stripes represent night flying, enemy searchlights, and the sky

▲ AIR CREW EUROPE STAR

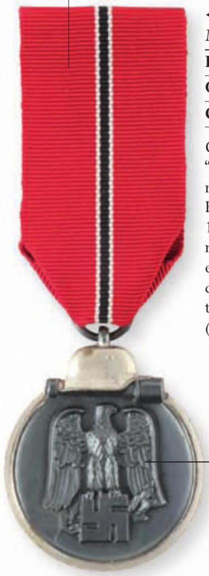
Date 1945

Origin UK

Conflict World War II

The rarest World War II campaign star, this medal was awarded for operations over Europe from UK bases from 3 September 1939 to 5 June 1944. The recipient had to hold the 1939–45 Star and have flown in operations for two months between these dates.

Ribbon colours said to represent blood, snow, and death



Eagle and swastika motif

◀ EASTERN FRONT MEDAL

Date 1942

Origin Germany

Conflict World War II

Commonly known as the "Ostmedaille", this award marked service on the Eastern Front between 15 November 1941 and 15 April 1942. In reference to the hardship endured during that winter, campaign, it was nicknamed the "Gefrierfleischorden" (Frozen Meat Medal).

KEY DEVELOPMENT

BATTLES AT SEA IN THE WORLD WARS

Command of the seas was a vital element in both world wars. The impact of submarines and aircraft created logistical complications, as well as new danger, for surface fleets, which were themselves increasingly devoted to the support of amphibious landings.

KEY **EVENTS**

1914–45

- **1914** In the second month of World War I, a single German U-boat in the North Sea sinks three British cruisers in one hour.
- **1916** Forty-four battleships – 28 British and 16 German – are present at the Battle of Jutland, but only a few are sunk in what is an indecisive encounter.
- **1941** The British battleship HMS *Prince of Wales* and the battle cruiser HMS *Repulse*, sailing off Malaya without air cover, are sunk by land-based Japanese bombers and torpedo aircraft.
- **1944** The US Navy deploys more than 200 ships against the Japanese at the battle of Leyte Gulf (see pp.348–49), off the Philippines, one of the largest naval battles in history.
- **1945** The German Type XXI U-boat enters frontline service. It is the first submarine able to submerge for long periods, rather than diving occasionally, and can travel at speed underwater.

Given the fleets of heavily gunned battleships built in the years leading up to the war, the naval battles of World War I did not follow expectations: there was no climactic, pitched battle between the German High Seas Fleet and the British Grand Fleet. On the only occasion when the two met, at Jutland in the summer of 1916, the Germans fled on discovering the full extent of the British fleet deployed against them, and escaped due to a bungled pursuit. In fact, British superiority in numbers was simply too great to be challenged, even though German warships proved to have better range-finding equipment, better protection against shells, and better night-fighting skills.

German surface warships had been expected to pose a serious threat to British merchant shipping, but it was the German U-boats that turned out to be the biggest threat. Having disposed of the majority of Germany's warships early in the conflict, Britain's Royal Navy were frighteningly vulnerable to mines and submarines, leading to caution in all fleet operations. The belated introduction of convoys accompanied by Royal Navy warships, from the summer of 1917, reduced losses, but U-boats remained a constant danger.

▼ AN AMPHIBIOUS TRUCK The American DUKW (or "Duck") was one of the ingenious vehicles developed for amphibious operations in World War II. It could carry 25 soldiers ashore and up a beach.

POST-WORLD WAR I

Proof of the effectiveness of submarines, and growing evidence for the importance of naval air power, failed to discourage navies from building bigger and better battleships after 1918. In the 1920s, the Royal Navy thought it had found the answer to the U-boat menace with the ASDIC sonar system, which pinpointed vessels underwater – not considering that they could attack by night on the surface, where their low profile made them virtually undetectable.

> "The only thing that ever **truly frightened me** during the war was the **U-boat peril**"
>
> **BRITISH PRIME MINISTER WINSTON CHURCHILL**

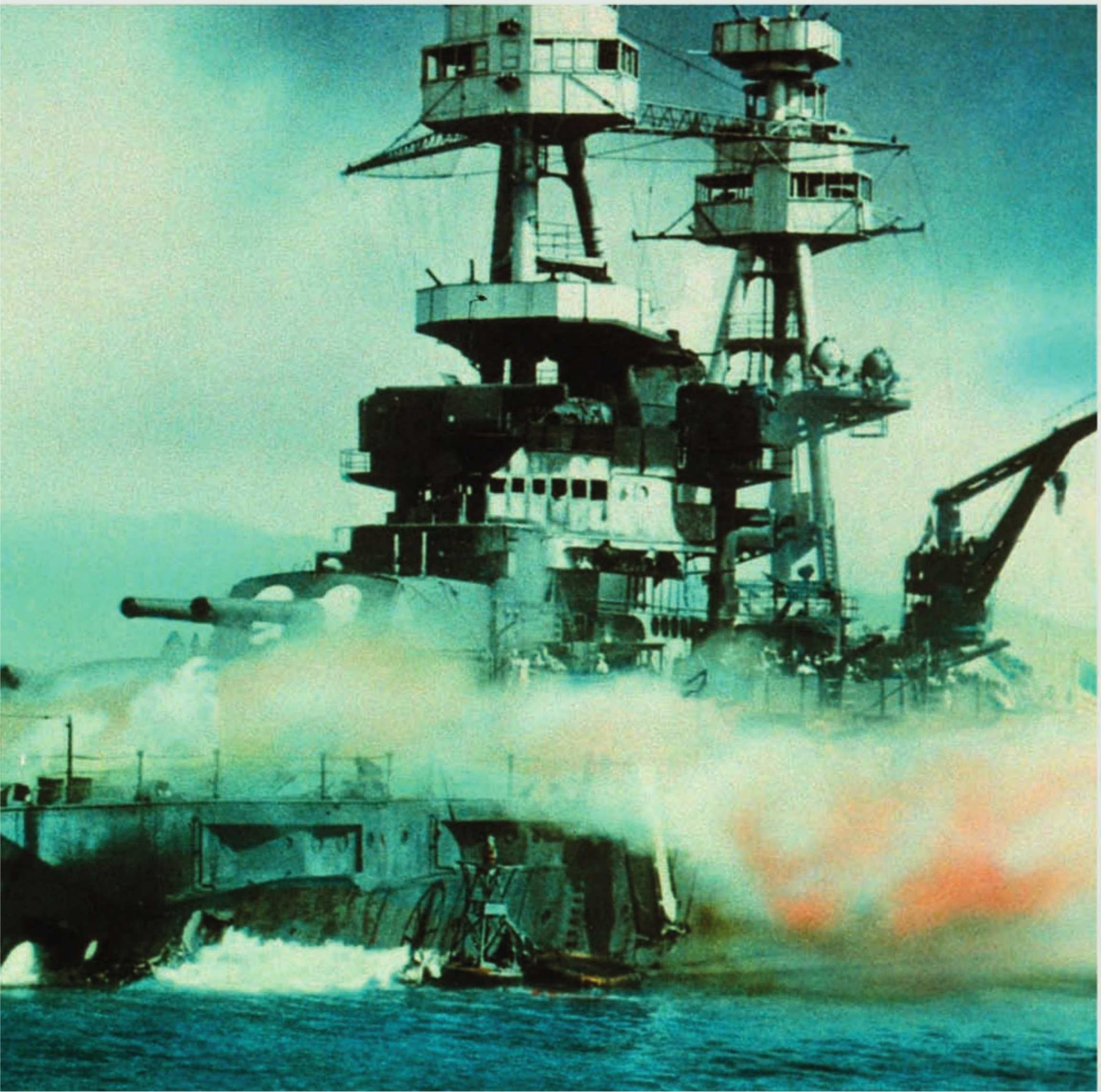
World War II brought epic naval conflicts in the Atlantic, Pacific, and Mediterranean, with the British, German, Italian, American, and Japanese navies engaged in fierce combat. This time the major shock for navies was the vulnerability of even the most powerful warships to air attack. Within range of hostile aircraft, surface ships were dangerously exposed without air cover. German magnetic mines caused havoc

at the start of the war, until the technique of degaussing ship's hulls (reducing their magnetism) was introduced.

Meanwhile, U-boats, coordinated by radio and with improved range, were even more destructive to merchant shipping than they had been in World War I. A combination of tactical and technological innovations were employed to meet this threat: these included improved radar on convoy escort ships, and high-frequency radio direction-finding equipment ("huff-duff").

When gun battles between large surface warships did occur, victory usually went to the side with superior radar and night-fighting equipment, as in the fighting between Japanese and American fleets around Guadalcanal, in 1942, or between the British and Italians in the Mediterranean. Eventual naval superiority allowed the Allies to mount numerous amphibious landings: the largest of these, at Normandy in June 1944, was supported by over 1,200 warships.

◄ **LOADING A TORPEDO**
The cramped conditions on World War II submarines made loading torpedoes in the torpedo tubes extremely difficult. On German U-boats – as with British submarines – the torpedo room also served as living accommodation.



◄ **PEARL HARBOR**
The USS *Nevada* was among the 18 American ships sunk or damaged in Japan's surprise attack on the US Pacific fleet on 7 December 1941, at Pearl Harbor. The Japanese force consisted of 353 fighter, bomber, and torpedo aircraft launched from six aircraft carriers, supported by midget submarines.

KEY **FIGURE**

ADMIRAL ISOROKU YAMAMOTO

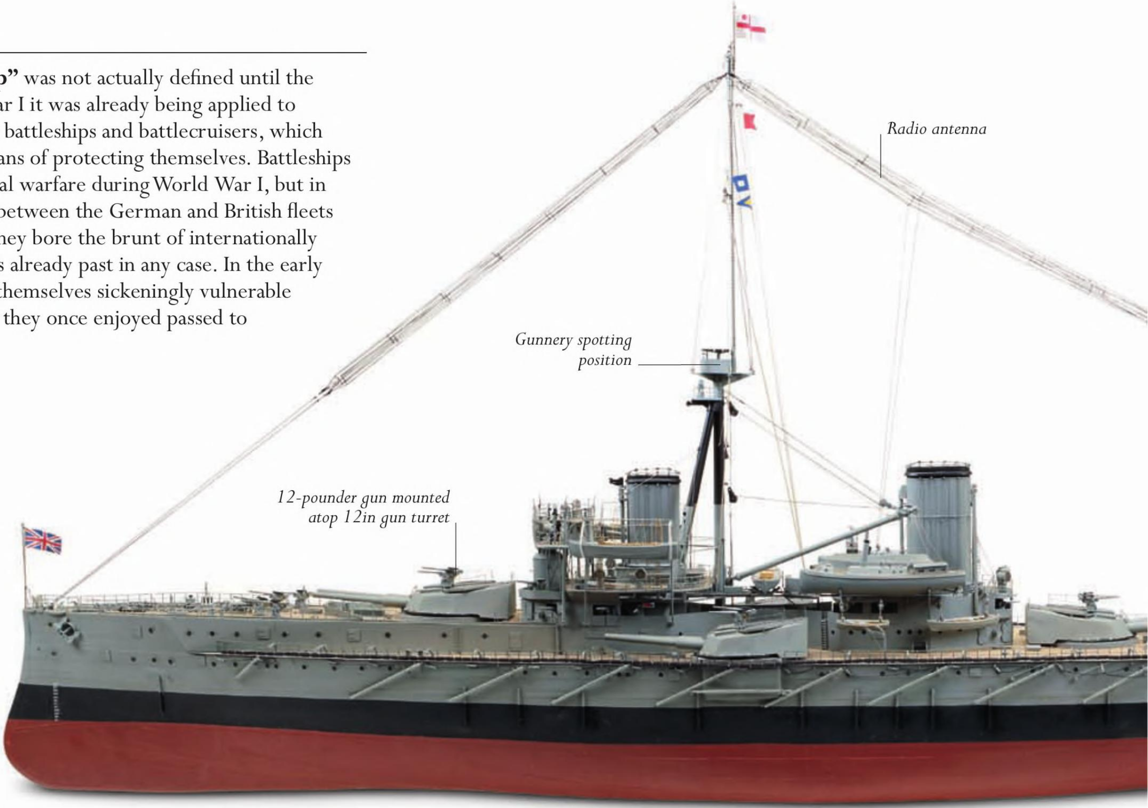
1884–1943

Having fought as an ensign at the Battle of Tsushima in 1904, Yamamoto rose to be commander-in-chief of the Japanese Combined Fleet by 1939. An advocate of naval air power, he planned the attack on Pearl Harbor that started the Pacific War in 1941.

▲ Yamamoto died when his transport aircraft was ambushed and shot down by US fighters.

CAPITAL SHIPS

Although the term "capital ship" was not actually defined until the 1920s, by the outbreak of World War I it was already being applied to the most powerful craft in the fleet: battleships and battlecruisers, which sacrificed armour for speed as a means of protecting themselves. Battleships seemed to dominate the field of naval warfare during World War I, but in fact the expected large-scale battle between the German and British fleets did not materialize. After the war, they bore the brunt of internationally mandated cuts, but their heyday was already past in any case. In the early stages of World War II they proved themselves sickeningly vulnerable to air attack, and the pride-of-place they once enjoyed passed to the aircraft carrier.


Radio antenna
Gunnery spotting position
12-pounder gun mounted atop 12in gun turret

▶ HMS DREADNOUGHT

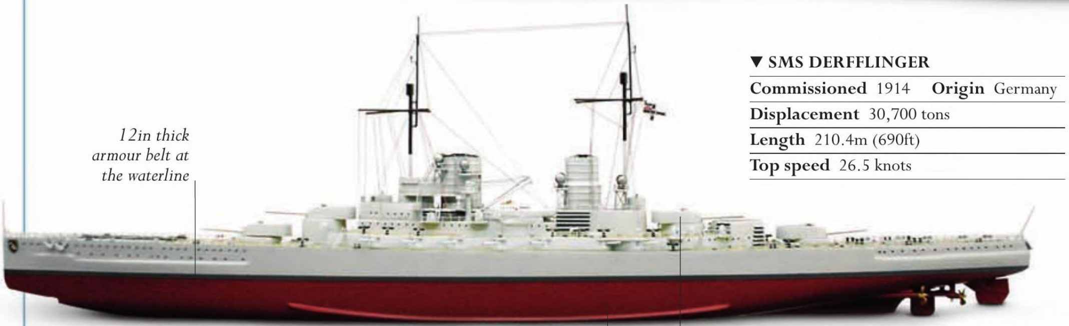
Commissioned 1906 **Origin** UK

Displacement 21,845 tons

Length 160.6m (527ft)

Top speed 21 knots

Dreadnought was ground-breaking in two respects: it was armed with big guns in all turrets and no "intermediates", and it was propelled by turbines, which both saved weight and increased speed. It was also better armoured than previous ships.


12in thick armour belt at the waterline
Double-skinned bulges gave protection against torpedoes
Two 30.5cm guns in turret

▼ SMS DERFFLINGER

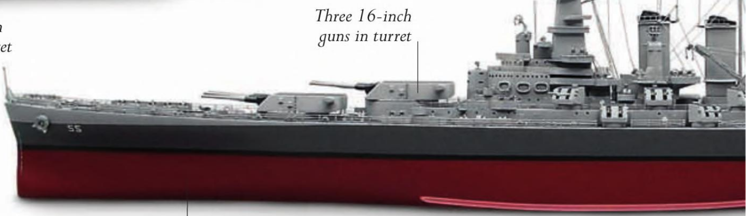
Commissioned 1914 **Origin** Germany

Displacement 30,700 tons

Length 210.4m (690ft)

Top speed 26.5 knots

Derfflinger was one of the 52 German ships scuttled at Scapa Flow on 21 June 1919, and was the last to be raised, in 1939. It was the German navy's fourth-generation battlecruiser, and was far superior to the British Royal Navy's versions.


Search radar antenna
Three 16-inch guns in turret
12in thick armour belt at the waterline

▼ HMS QUEEN MARY

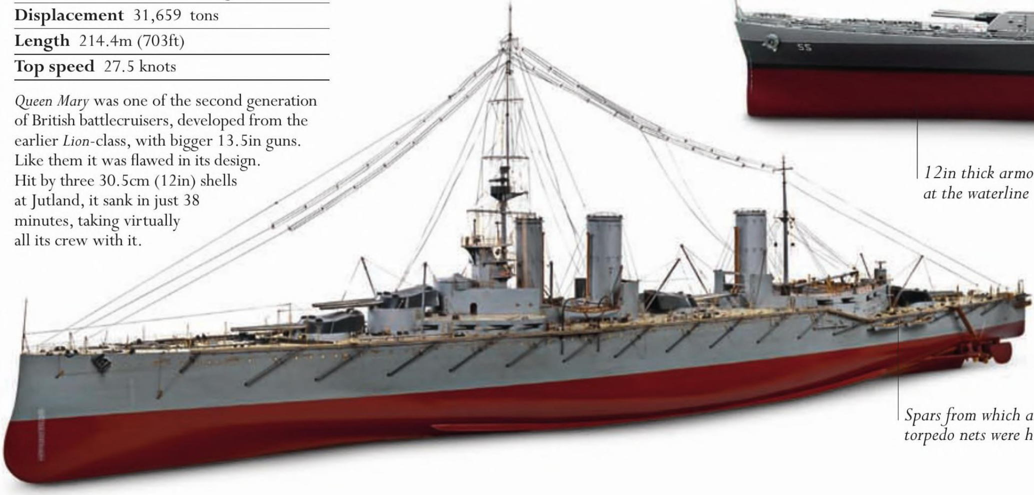
Commissioned 1913 **Origin** UK

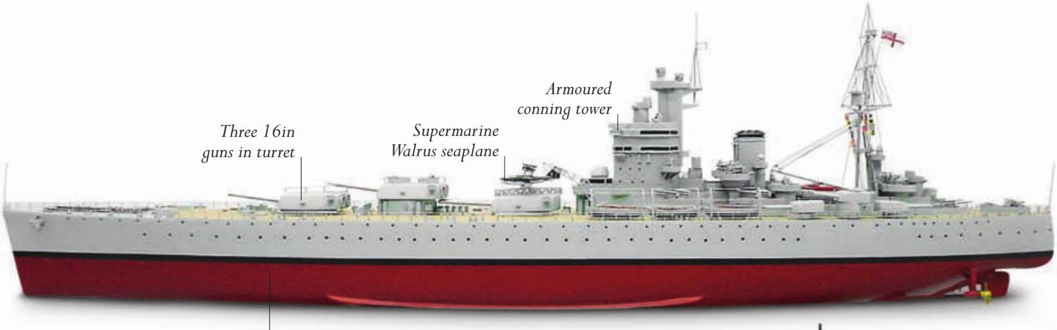
Displacement 31,659 tons

Length 214.4m (703ft)

Top speed 27.5 knots

Queen Mary was one of the second generation of British battlecruisers, developed from the earlier *Lion*-class, with bigger 13.5in guns. Like them it was flawed in its design. Hit by three 30.5cm (12in) shells at Jutland, it sank in just 38 minutes, taking virtually all its crew with it.

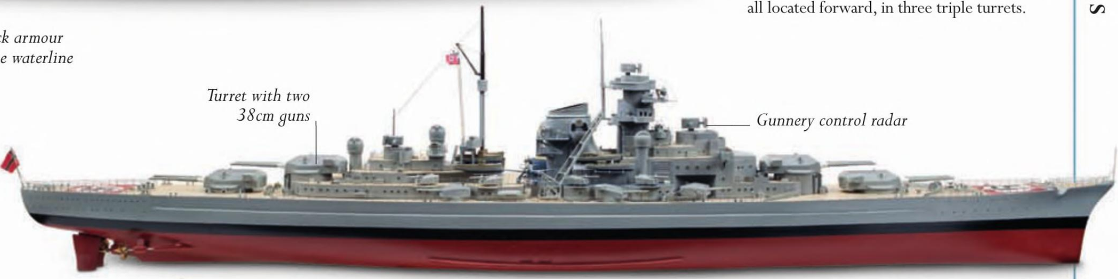

Spars from which anti-torpedo nets were hung


Three 16in guns in turret
Supermarine Walrus seaplane
Armoured conning tower
14in thick armour belt at the waterline

◀ HMS RODNEY

Commissioned 1927 **Origin** UK
Displacement 45,200 tons
Length 216.4m (710ft)
Top speed 23 knots

Built to the limits imposed by the Washington Naval Treaty, *Rodney* and its sister-ship *Nelson* were characterized by the unconventional layout of their main armament – their 16in guns were all located forward, in three triple turrets.


Turret with two 38cm guns
Gunnery control radar

Two 12in guns in turret
11in thick armour belt at the waterline
Twin rudders

▲ BISMARCK

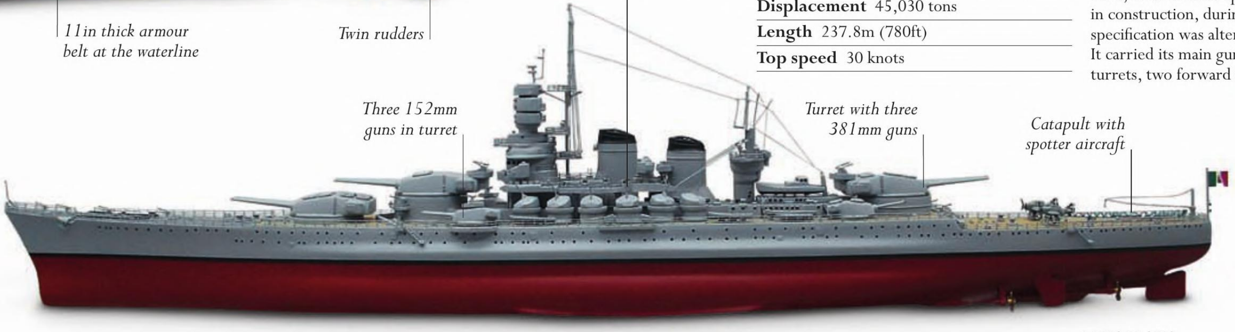
Commissioned 1940 **Origin** Germany
Displacement 50,900 tons
Length 248m (814ft)
Top speed 29 knots

The pride of the Kriegsmarine, *Bismarck* and its sister-ship *Tirpitz* achieved iconic status. Both ships acted as a deterrent that drained British naval resources, although *Bismarck*'s effective action was limited to the destruction of HMS *Hood*. It was sunk in 1941 after being holed by British torpedo bombers.

▼ VITTORIO VENETO

Commissioned 1940 **Origin** Italy
Displacement 45,030 tons
Length 237.8m (780ft)
Top speed 30 knots

One of just three fast battleships built for the Regia Marina between the world wars, *Vittorio Veneto* spent over five years in construction, during which time its specification was altered significantly. It carried its main guns in triple turrets, two forward and one aft.


90mm anti-aircraft gun
Three 152mm guns in turret
Turret with three 381mm guns
Catapult with spotter aircraft

Catapult for launching spotter aircraft
55

◀ USS NORTH CAROLINA

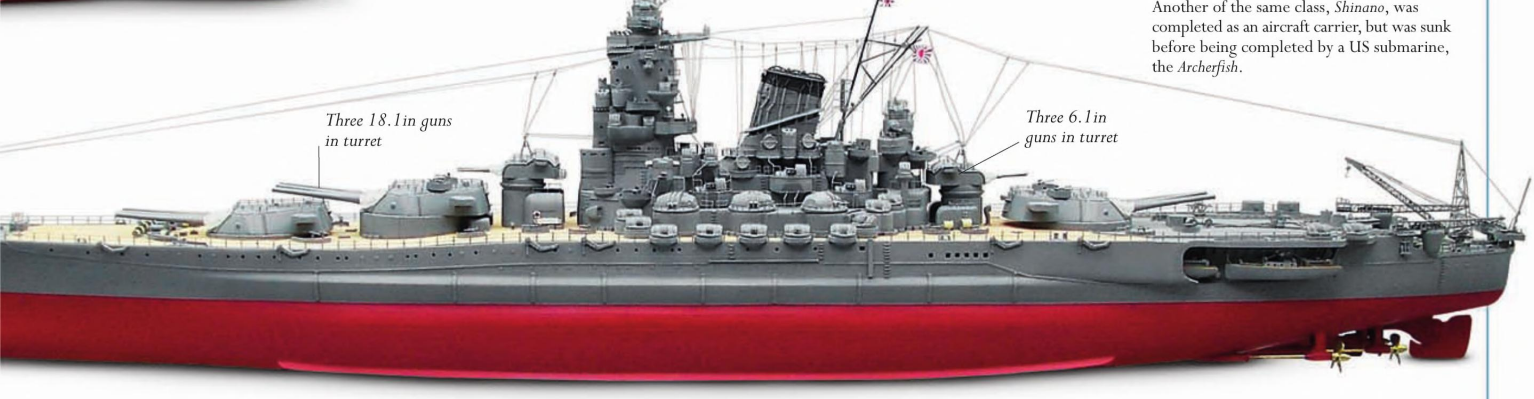
Commissioned 1941 **Origin** US
Displacement 44,380 tons
Length 222.1m (729ft)
Top speed 28 knots

North Carolina and its sister-ship *Washington* marked a departure in US battleship design when they were built. They were bigger and much faster than those laid down at the end of World War I, and were equipped with much more powerful armament. *North Carolina*, "The Showboat", is preserved at Wilmington in its home state.

▼ YAMATO

Commissioned 1941 **Origin** Japan
Displacement 69,990 tons
Length 263m (863ft)
Top speed 27 knots

Yamato and its sister-ship *Musashi* were the biggest battleships ever constructed, and mounted the most powerful armament. However, both succumbed to air attack. Another of the same class, *Shinano*, was completed as an aircraft carrier, but was sunk before being completed by a US submarine, the *Archerfish*.


Three 18.1in guns in turret
Three 6.1in guns in turret

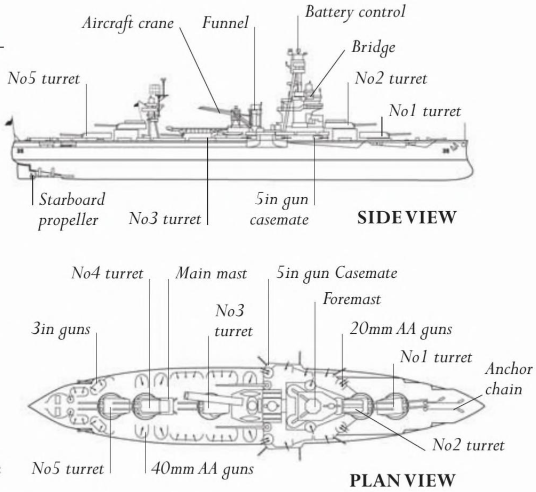
SUPER-DREADNOUGHT BATTLESHIP

USS TEXAS

The *Texas* was the product of the naval arms race that preceded World War I. A “super-dreadnought”, it earned five battlestars during a long service career that spanned more than 30 years.

With a main armament of ten 14in guns, the *Texas* entered service in 1914 as the world’s most powerful warship. In some respects it was behind the times, especially in using coal-fired reciprocating engines rather than oil-fired steam turbines. An extensive modernization in 1927 installed oil-fired boilers, improved the ship’s armour, and upgraded its fire-control systems. Later changes included the addition of many anti-aircraft guns and fire-control and air-defence radars.

By World War II, the *Texas* was too slow to keep up with more modern capital ships in combat, but its guns still packed a powerful punch. The *Texas* escorted convoys in the Atlantic before the USA entered the war. Later, the ship was prominent in a shore bombardment role, providing fire support for landings in North Africa, Normandy (see pp. 340–41), Iwo Jima, and Okinawa. The *Texas* suffered only one combat fatality, when its conning tower was hit by a shell from a German shore battery in 1944.


Battery control
Aircraft crane
Funnel
Bridge
No5 turret
No2 turret
No1 turret
Starboard propeller
No3 turret
5in gun casemate
SIDE VIEW
No4 turret
Main mast
5in gun Casemate
Foremast
No3 turret
3in guns
20mm AA guns
No1 turret
Anchor chain
No2 turret
No5 turret
40mm AA guns
PLAN VIEW

▲ **USS *TEXAS***
A New-York-class battleship, the *Texas* was built at a cost of around $6 million. It was 175m (574ft) long, displaced 27,000 tons, and had a top speed of 21 knots.

AROUND THE DECK

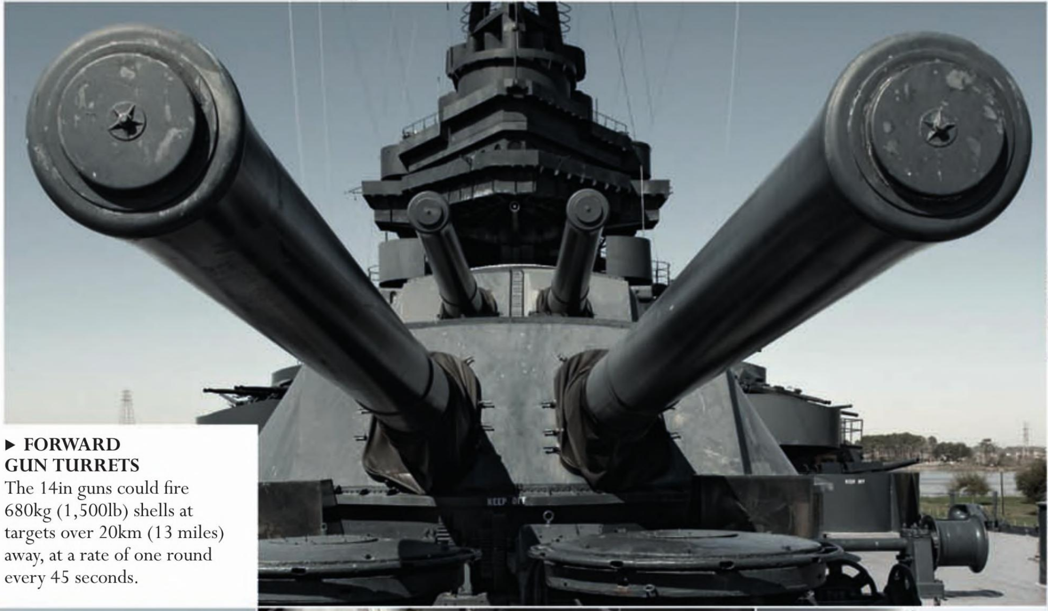
▲ **REAR VIEW OF FOREMAST**
Below the battery control are other areas that need a high, clear line of sight such as the bridge and lookout platforms.

▶ **SHIP’S BELL**
Used to mark the time of day and regulate duty watches, this large brass bell on the deck was engraved with the ship’s name.

▲ **ANCHOR CAPSTANS**
In front of the 14in bow guns, two large electric capstans rotated to raise or lower the anchors. At the stern there are other capstans, which were used for towing.

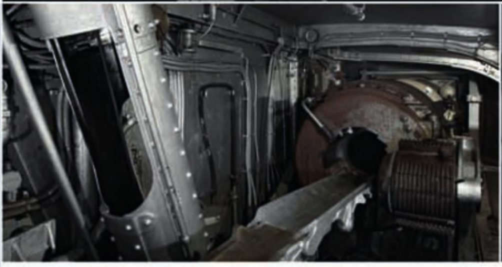
▲ **BATTERY CONTROL**
Observers in the battery control relayed readings for range, speed, and bearing to the plotting room below deck which, in turn, sent instructions to the gunners.

▶ **SOLE SURVIVOR**
Decommissioned in 1946, the USS *Texas* is now a museum ship at San Jacinto, Texas. It is the last surviving dreadnought-era battleship.



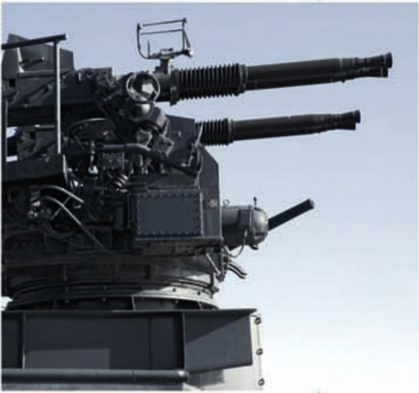
▸ FORWARD GUN TURRETS
The 14in guns could fire 680kg (1,500lb) shells at targets over 20km (13 miles) away, at a rate of one round every 45 seconds.

▲ ANTI-AIRCRAFT GUNS
During the late 1920s, the *Texas* received sixteen 5-inch and eight 3-inch anti-aircraft guns.



▲ INTERIOR OF 14IN TURRET
Shells raised from the magazine were rolled onto the loading tray. The shell and charge bags were rammed into the breech and the breech door closed, ready for firing.

▲ 20MM CANNON
As a last-ditch defence against aircraft, the *Texas* carried forty-four 20mm Oerlikon cannon.



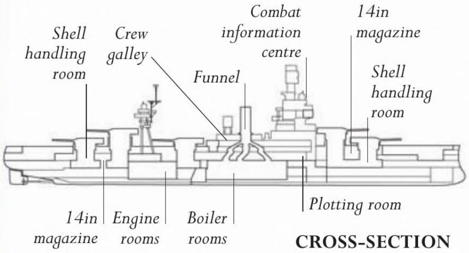
▲ BOFORS 40MM GUN
The ship's 40 Bofors anti-aircraft guns, a World War II addition, were remotely controlled.

▲ PARAVANE
The two paravanes were towed from the bow to snag the lines of submerged mines.

▲ LINE CUTTER
Each paravane had a blade to cut mines loose so that they floated to the surface.

BELOW DECKS

Home to a complement of about 1,800 men and officers by 1945, the *Texas* was like a small town, with a post office, dentist, and barber's shops – but no liquor store, as alcohol consumption was banned on all US Navy ships. There were few frills on board: most men ate where they slept, and toilet and bathing facilities were quite primitive. It was, however, a well-organized world in which each man knew his place, and in which basic needs of health and nutrition were properly addressed.



CROSS-SECTION

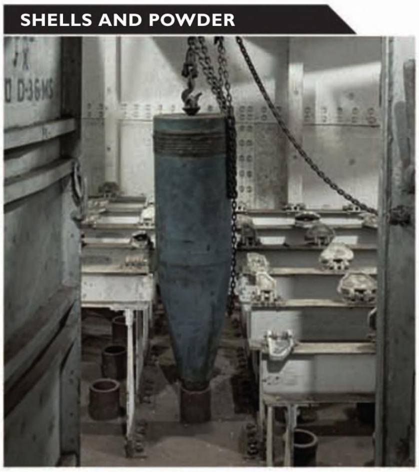
COMMAND AND CONTROL

▲ COMBAT ROOM
Staff in the Combat Information Centre assessed data from the radar (a World War II addition) and other sources. They also coordinated the weapons systems.

▲ PILOT HOUSE
The pilot house, located on the bridge, contained the main steering position. It was equipped with wheel, compass, rudder-angle indicator, and engine room telegraph.

◄ CHART ROOM
Adjacent to the pilot house, the chart room was where the navigating officer worked. The devices on the wall above the chart table are depth and speed indicators.

SHELLS AND POWDER



▲ 14IN SHELL HOIST
Shells and charges stored in magazines well below the water line were brought up to the handling rooms and readied for use.

▲ POWDER SCUTTLES
Propellent powder, stored far from the shells, was sent to the handling rooms via flash-proof scuttles to prevent accidental ignition.

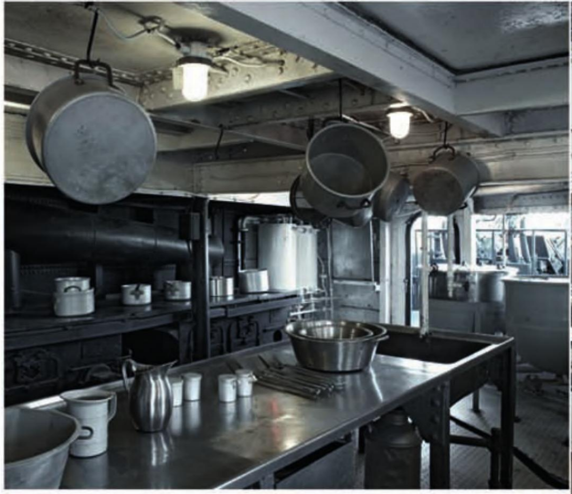
BOILERS AND RUDDER

◄ BURNER NOZZLE DETAIL
The burners forced fuel oil through atomizers, creating a spray of mist that was burned to heat the water. The red bar was used to adjust the volume and fineness of the spray.

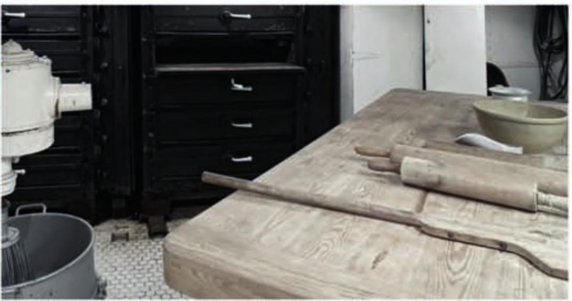
▲ EMERGENCY STEERING POSITION
Normally the twin rudders were turned by electric motors, but if the power failed, the ship could be steered manually by teams of 16 men, using four large wheels.

► OIL-FIRED BOILER
After the Texas's refit in 1927, steam to drive the two vertical, triple-expanding engines was produced by six oil-fired boilers. Each boiler had eight burners; three have been removed here to reveal the interior.

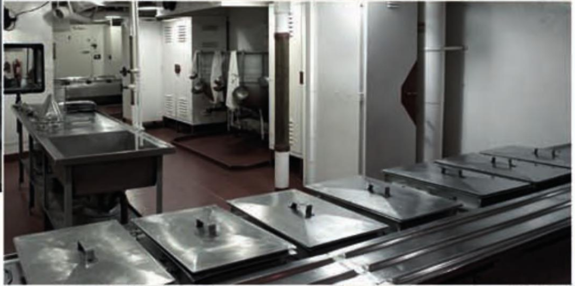
LIFE ON BOARD



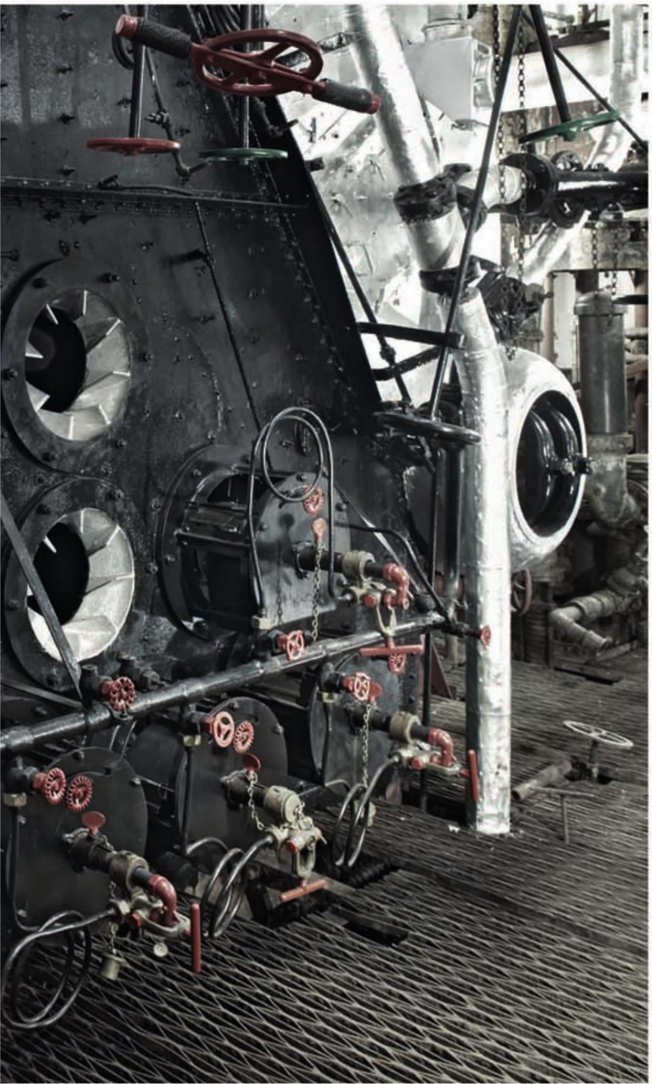
▲ ENLISTED MEN'S GALLEY
The galley, on the main deck, could be opened up on three sides to provide ventilation. Food was sent down to the cafeteria on the deck below.

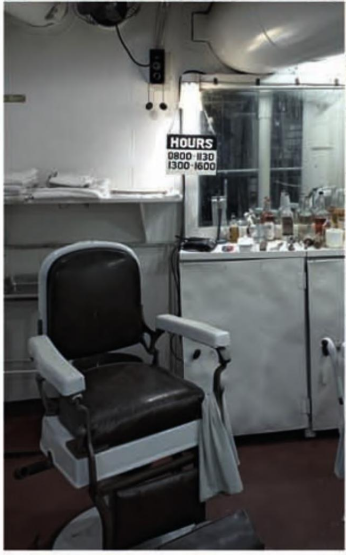


◀ BAKERY
The bakery was positioned near to the galley on the port side of the main deck, so that the ovens could be cooled by fresh air.

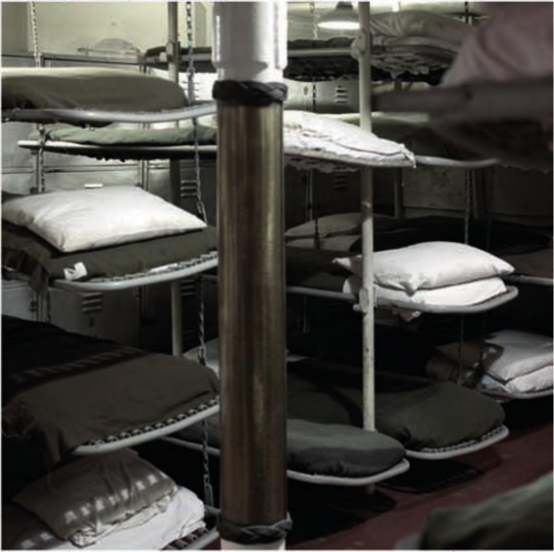


◀ CAFETERIA
Food arriving from the galley above via dumbwaiter was put into heated serving containers. Most enlisted men ate off foldaway tables in their berthing areas.

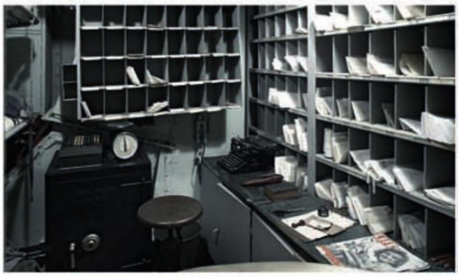




▲ BARBER'S SHOP
This barber's shop looked after the enlisted men – officers had their own barber's shop further forward.



▲ MARINE BERTHS
Like enlisted sailors, the marines on the ship slept in bunks stacked three or four high. Most berthing areas were on the second deck.

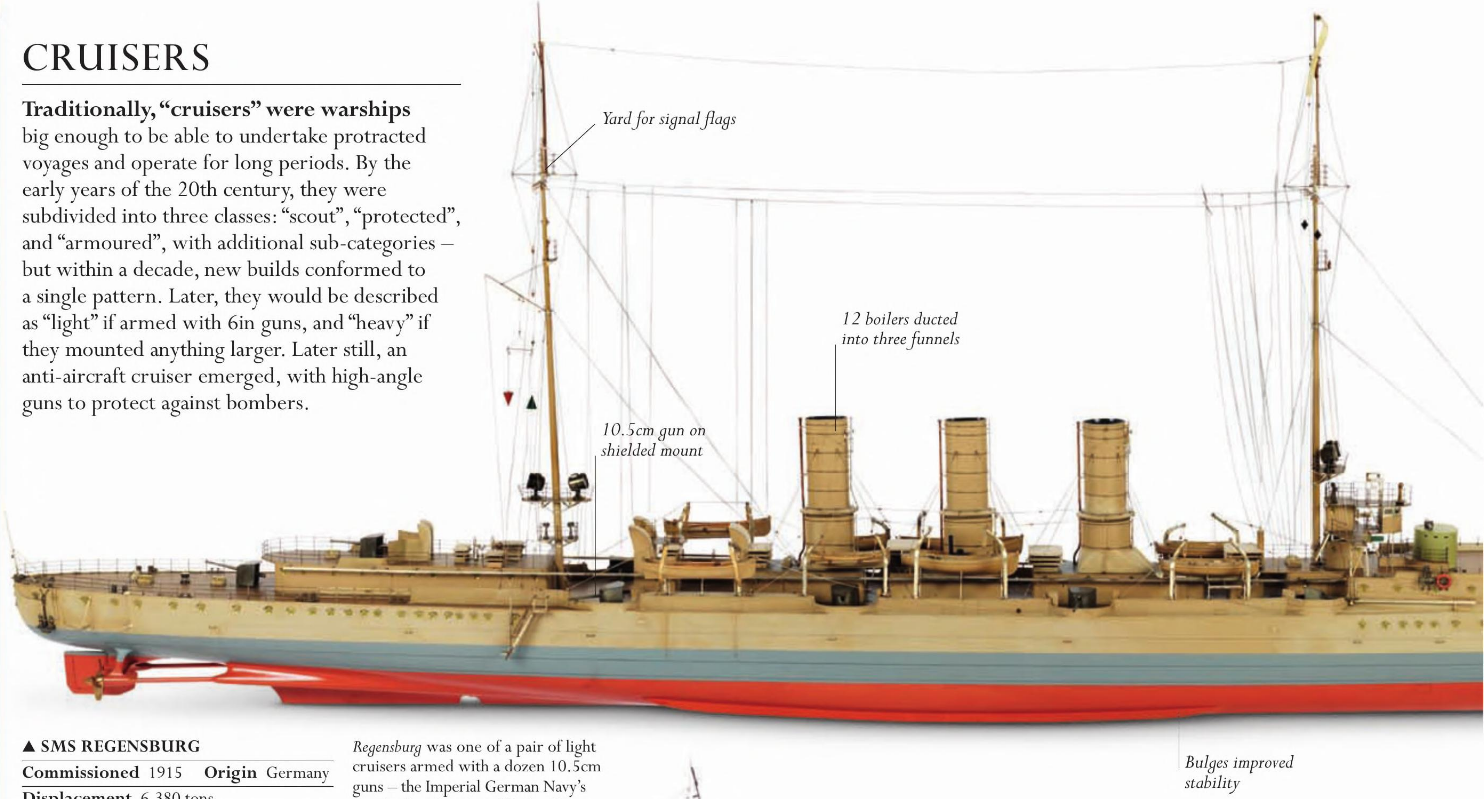


▲ POST OFFICE
Letters from family, friends, and loved ones reached the sailors through the ship's post office, providing an important boost to crew morale.

▲ CREW LOCKER
Privacy and space were limited, but each person had a locker for personal possessions.

CRUISERS

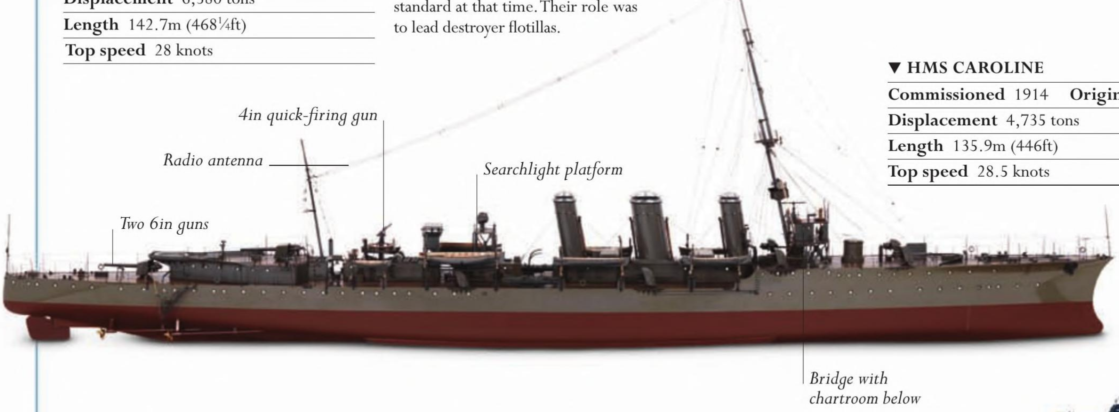
Traditionally, "cruisers" were warships big enough to be able to undertake protracted voyages and operate for long periods. By the early years of the 20th century, they were subdivided into three classes: "scout", "protected", and "armoured", with additional sub-categories – but within a decade, new builds conformed to a single pattern. Later, they would be described as "light" if armed with 6in guns, and "heavy" if they mounted anything larger. Later still, an anti-aircraft cruiser emerged, with high-angle guns to protect against bombers.


Yard for signal flags
12 boilers ducted into three funnels
10.5cm gun on shielded mount
Bulges improved stability

▲ SMS REGENSBURG

Commissioned 1915 **Origin** Germany
Displacement 6,380 tons
Length 142.7m (468¼ft)
Top speed 28 knots

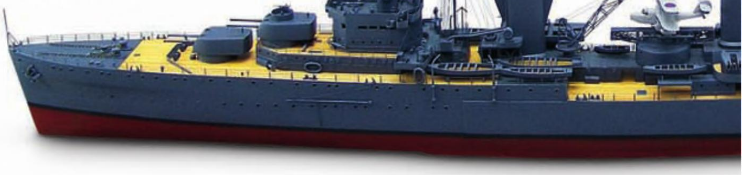
Regensburg was one of a pair of light cruisers armed with a dozen 10.5cm guns – the Imperial German Navy's standard at that time. Their role was to lead destroyer flotillas.


4in quick-firing gun
Radio antenna
Searchlight platform
Two 6in guns
Bridge with chartroom below

▼ HMS CAROLINE

Commissioned 1914 **Origin** UK
Displacement 4,735 tons
Length 135.9m (446ft)
Top speed 28.5 knots

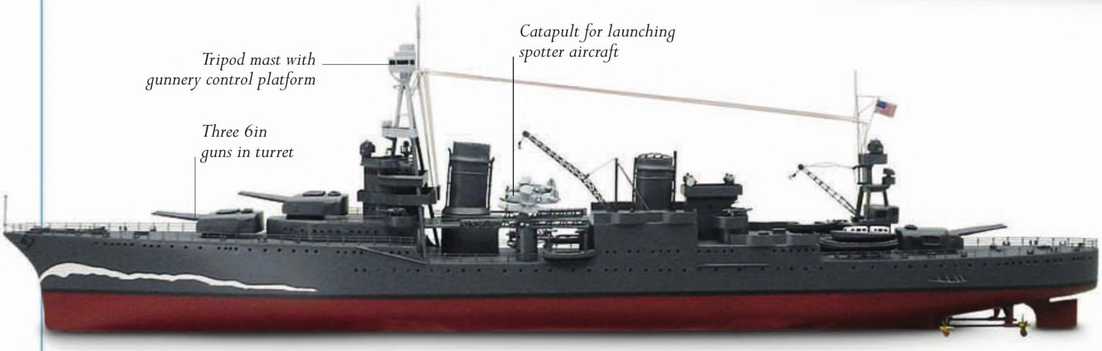
The lead ship of a group of six fast, light cruisers intended as destroyer flotilla leaders, HMS *Caroline* saw active service at Jutland. In 1924, it became a training ship at Belfast, Northern Ireland, where it remains today.



▶ PERTH

Commissioned 1936 **Origin** UK
Displacement 9,150 tons
Length 171.4m (562½ft)
Top speed 32.5 knots

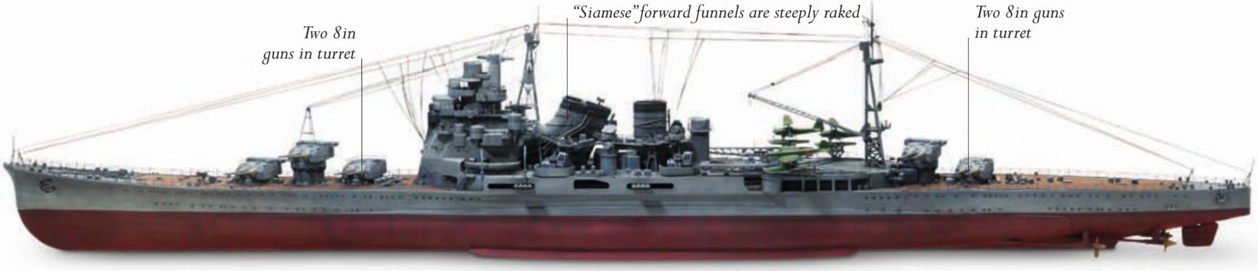
This ship was the leader of a class of three light cruisers – *Perth*, *Hobart*, and *Sydney* – which were transferred to the Royal Australian Navy. They were quite small by later standards, but gave good service. Although *Perth* and *Sydney* were both war losses, the latter destroyed the German commerce raider *Kormorant* in the process.


Catapult for launching spotter aircraft
Tripod mast with gunnery control platform
Three 6in guns in turret

◀ USS NORTHAMPTON

Commissioned 1930 **Origin** US
Displacement 11,420 tons
Length 183m (600¼ft)
Top speed 32.5 knots

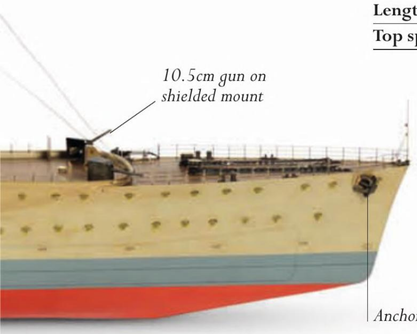
The design of this leader of a class of six armoured heavy cruisers was compromised by the constraints of the Washington Naval Treaty of 1922. It was ultimately sunk by torpedoes during the short but hectic Battle of Tassafaronga on the night of 30 November 1942.

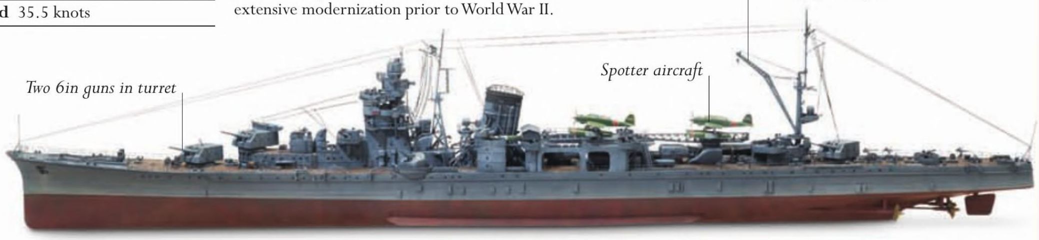

Two 8in guns in turret
"Siamese" forward funnels are steeply raked
Two 8in guns in turret

▲ TAKAO

Commissioned 1932 **Origin** Japan
Displacement 12,780 tons
Length 203.8m (668½ft)
Top speed 35.5 knots

Heavy cruiser development in Japan under the Naval Treaties, which ran from 1922 to 1936, followed a straightforward path of increasing size and performance, and the four *Takao*-class sat at its midpoint. Most ships saw further extensive modernization prior to World War II.

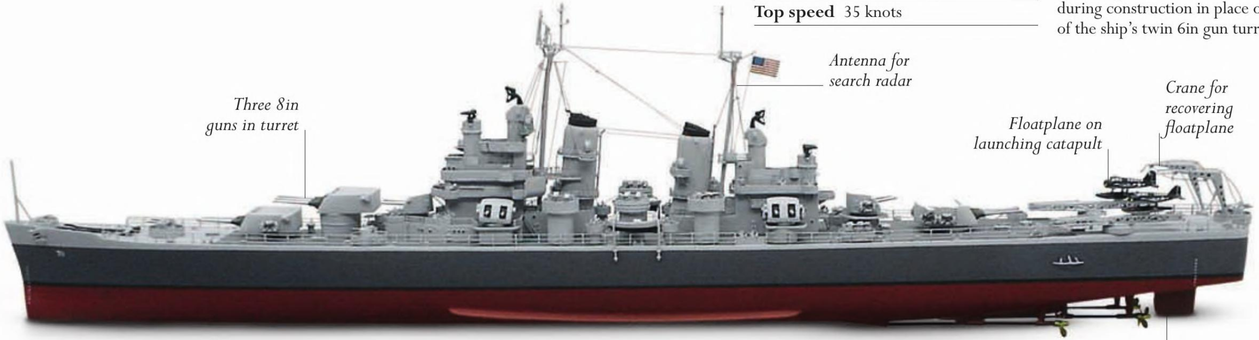

10.5cm gun on shielded mount
Anchor


Two 6in guns in turret
Spotter aircraft
Crane for recovering aircraft

▲ YAHAGI

Commissioned 1943 **Origin** Japan
Displacement 8,535 tons
Length 174.1m (571¼ft)
Top speed 35 knots

Yahagi was one of four light cruisers of the *Agano* class that were built as fast destroyer squadron leaders, all but one of which were war losses. Mountings for two aircraft were added during construction in place of one of the ship's twin 6in gun turrets.


Three 8in guns in turret
Antenna for search radar
Floatplane on launching catapult
Crane for recovering floatplane
Twin rudders improved manoeuvrability

▲ USS QUINCY

Commissioned 1943 **Origin** US
Displacement 17,030 tons
Length 205.3m (673½ft)
Top speed 33 knots

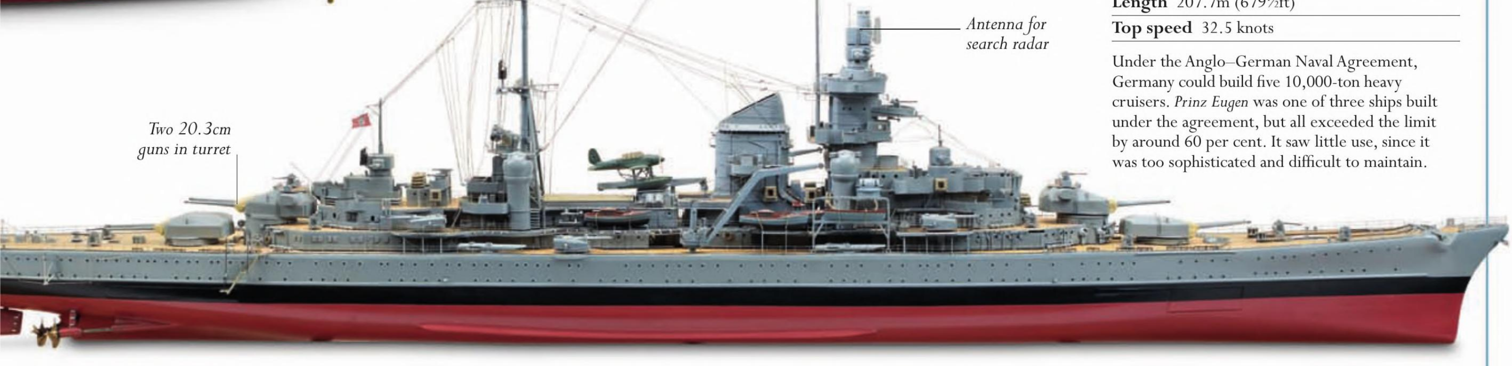
During World War II, the US Navy stuck to a tried-and-tested formula – optimizing both light and heavy cruisers for anti-aircraft duties. The *Baltimores*, such as USS *Quincy*, fell into that latter category; 24 were ordered, and 18 were actually built. The latter served right through to the 1970s.

Two 6in guns in turret

▼ PRINZ EUGEN

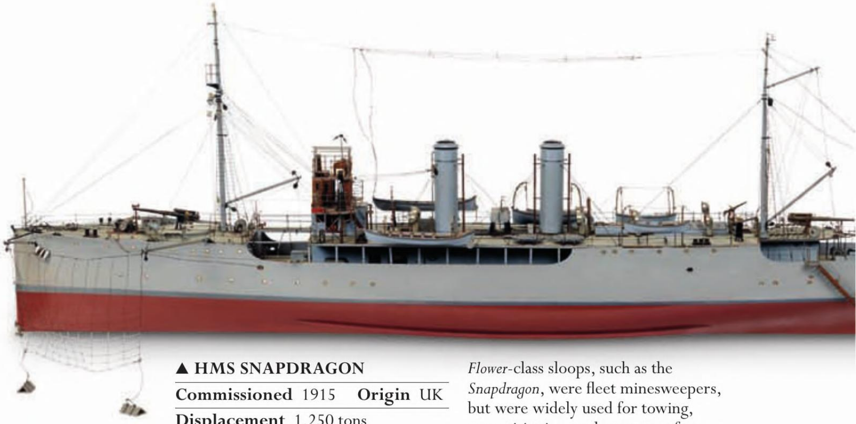
Commissioned 1940 **Origin** Germany
Displacement 19,040 tons
Length 207.7m (679½ft)
Top speed 32.5 knots

Under the Anglo–German Naval Agreement, Germany could build five 10,000-ton heavy cruisers. *Prinz Eugen* was one of three ships built under the agreement, but all exceeded the limit by around 60 per cent. It saw little use, since it was too sophisticated and difficult to maintain.


Antenna for search radar
Two 20.3cm guns in turret

DESTROYERS AND ESCORTS

By the outbreak of World War I, destroyers had grown in size, and now displaced 1,000 tons or more. They were still built for speed – well over 30 knots was normal – and mounted 4-inch guns or larger, as well as torpedoes. Their primary function during conflict was to defend the battle fleet against attack from similar ships or torpedo-boats, although they were also used to hunt submarines. The battle fleet became an obsolete concept by 1939, but destroyers survived. Enlarged still further, up-gunned, and armed with an array of depth-charges, they were employed – along with a new generation of smaller escorts – to guard convoys of merchant ships against attack from submarines and aircraft.



▲ HMS SNAPDRAGON

Commissioned 1915 **Origin** UK

Displacement 1,250 tons

Length 81.7m (268ft)

Top speed 16 knots

Flower-class sloops, such as the *Snapdragon*, were fleet minesweepers, but were widely used for towing, reprovisioning, and crew transfers. They were built in large numbers by non-specialist yards.

▶ SMS G37 (1914)

Commissioned 1915

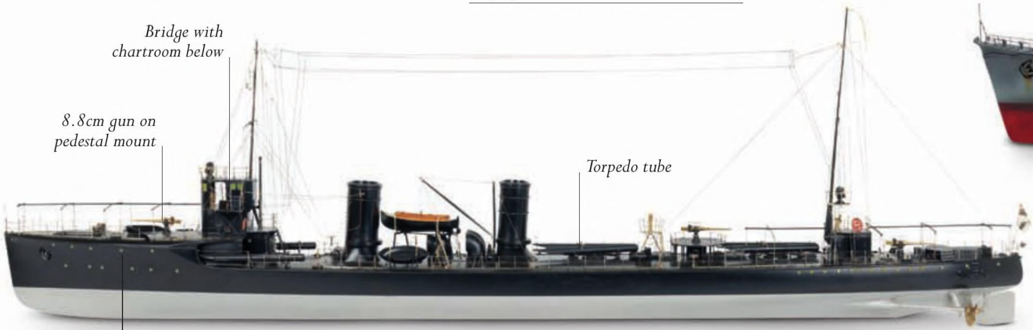
Origin Germany

Displacement 1,050 tons

Length 79.5m (260ft)

Top speed 34.5 knots

Krupp-Germaniawerft's *G37*-class followed an experimental design. They had a shorter forecastle in an attempt to improve their rough-weather performance. *G37* was mined in November 1917, in the North Sea.



Bridge with chartroom below

8.8cm gun on pedestal mount

Torpedo tube

Smaller forecastle for stability in bad weather

▼ HMS AVON VALE

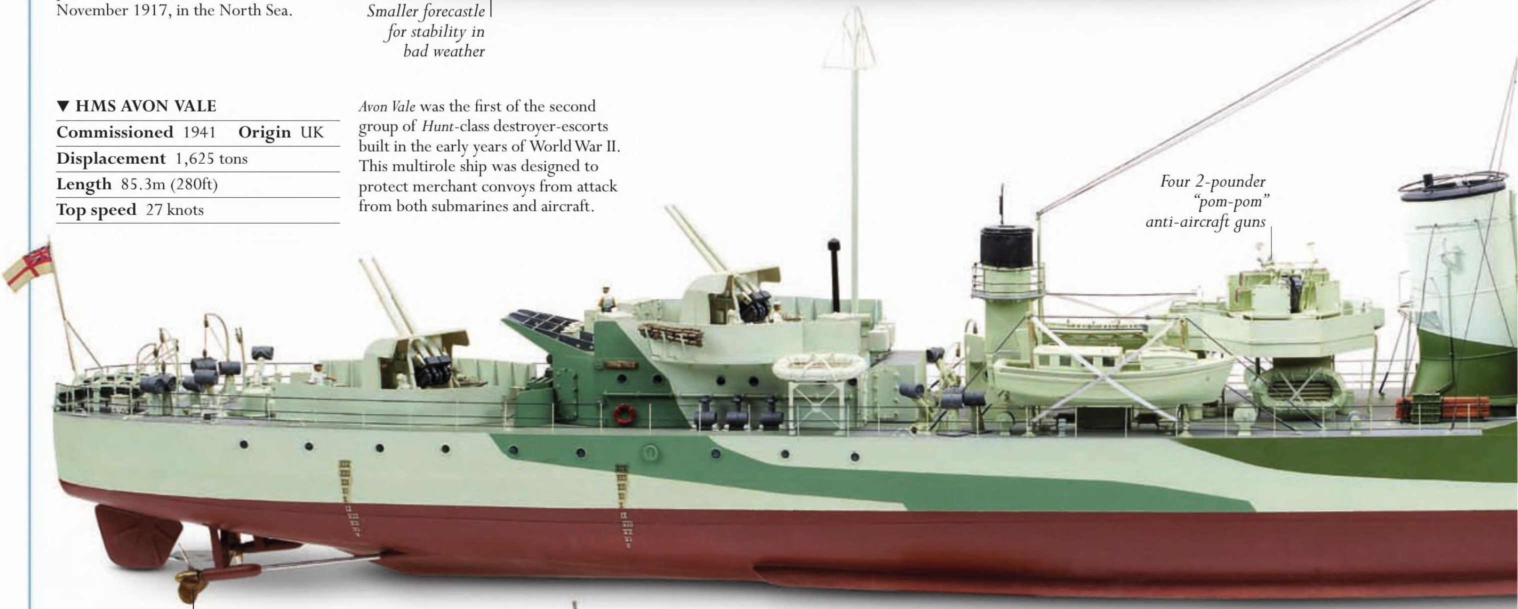
Commissioned 1941 **Origin** UK

Displacement 1,625 tons

Length 85.3m (280ft)

Top speed 27 knots

Avon Vale was the first of the second group of *Hunt*-class destroyer-escorts built in the early years of World War II. This multirole ship was designed to protect merchant convoys from attack from both submarines and aircraft.



Four 2-pounder "pom-pom" anti-aircraft guns

Twin propellers driven by steam turbines

▼ HMS ACANTHUS

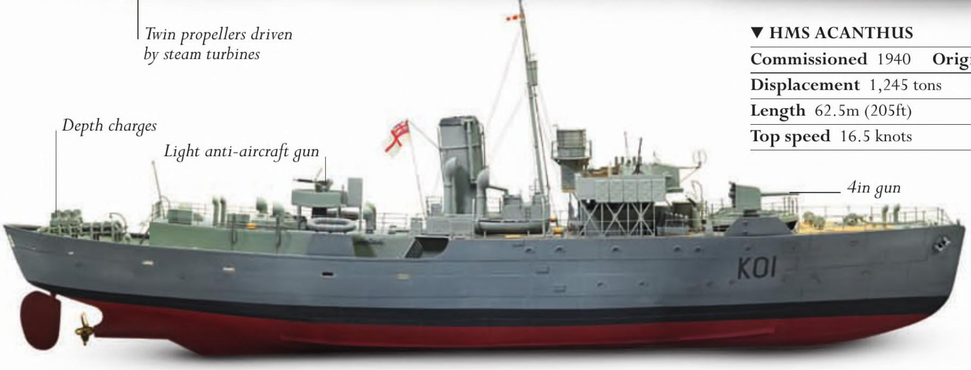
Commissioned 1940 **Origin** UK

Displacement 1,245 tons

Length 62.5m (205ft)

Top speed 16.5 knots

Corvettes such as HMS *Acanthus* were the smallest purpose-built warships used for convoy escort duties during World War II. Their design was based on that of commercial whale-catchers, and they were powered by piston engines, rather than turbines.

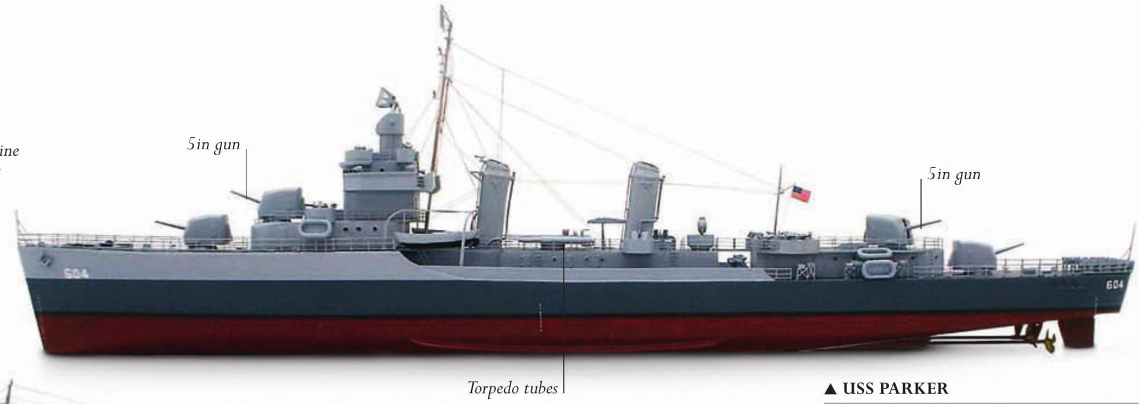


Depth charges

Light anti-aircraft gun

4in gun

Derrick for mine sweeping gear

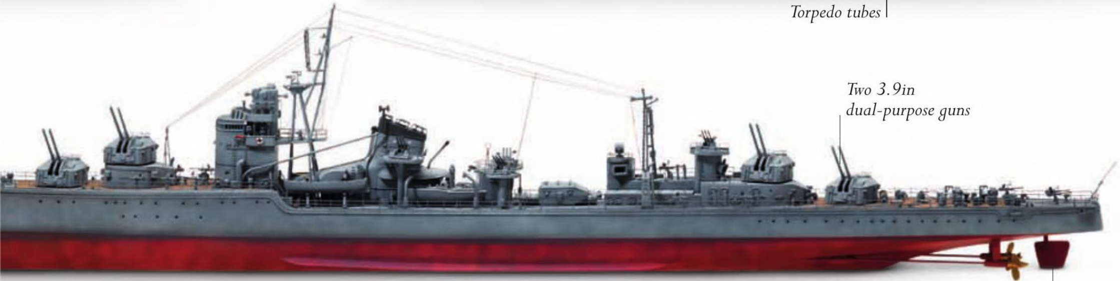


5in gun
5in gun
Torpedo tubes

▲ USS PARKER

Commissioned 1942 **Origin** US
Displacement 2,395 tons
Length 106.2m (348⅓ft)
Top speed 35 knots

The USS *Parker* was one of the later units of the *Benson/Gleaves*-class destroyers, which were the last that were designed for the US Navy before World War II. In the *Parker*, the weapons fit was reduced from five to four 5in guns in single turrets, and the space was given over to light anti-aircraft guns.

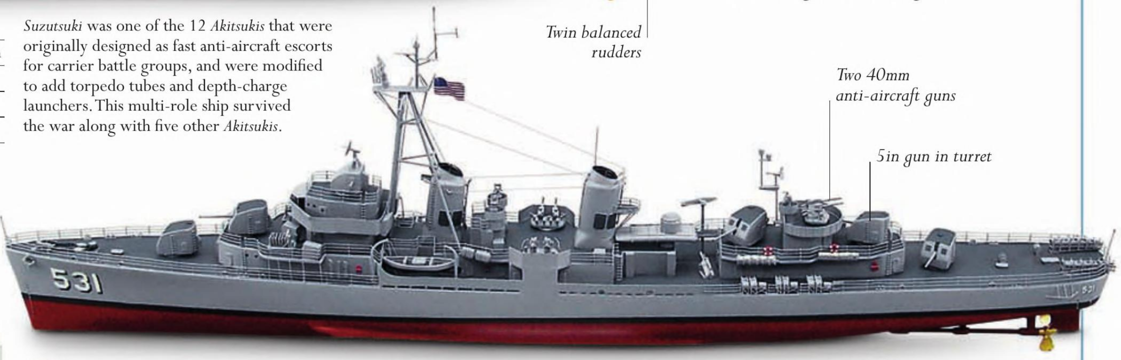


Two 3.9in dual-purpose guns
Twin balanced rudders

▲ SUZUTSUKI

Commissioned 1942 **Origin** Japan
Displacment 3,700 tons
Length 134.2m (440¼ft)
Top speed 33 knots

Suzutsuki was one of the 12 *Akitsukis* that were originally designed as fast anti-aircraft escorts for carrier battle groups, and were modified to add torpedo tubes and depth-charge launchers. This multi-role ship survived the war along with five other *Akitsukis*.



Two 40mm anti-aircraft guns
5in gun in turret

▲ USS HAZELWOOD

Commissioned 1943 **Origin** US
Displacement 2,925 tons
Length 114.7m (376½ft)
Top speed 38 knots

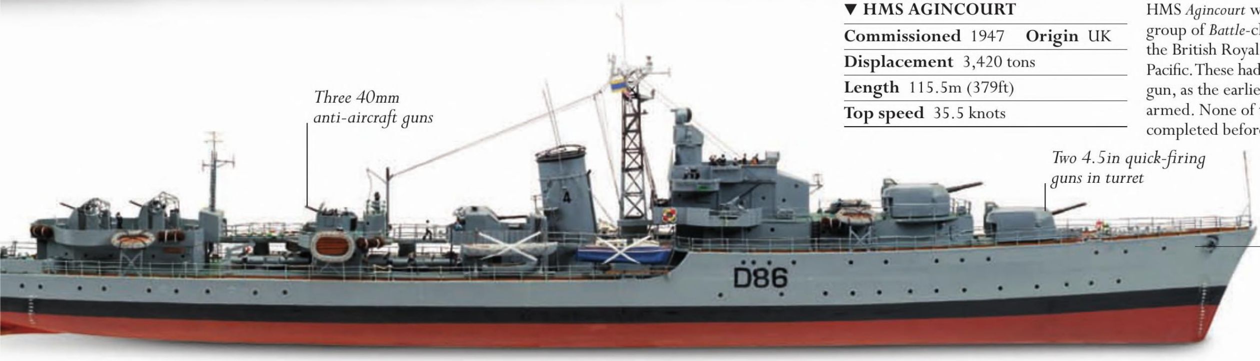
The *Fletcher*-class destroyers were the first that the US Navy built without regard to the limits of the Naval Treaties, the design being drawn up in 1939. In all, 175 were built till 1944 in yards all across the US. Many, including USS *Hazelwood*, were re-activated from reserve during the Korean War.

Bridge
Two 4in quick-firing guns on high-angle mount

▼ HMS AGINCOURT

Commissioned 1947 **Origin** UK
Displacement 3,420 tons
Length 115.5m (379ft)
Top speed 35.5 knots

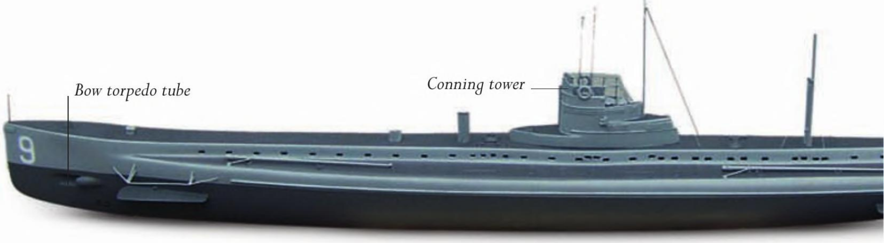
HMS *Agincourt* was the first of the second group of *Battle*-class destroyers built for the British Royal Navy for operations in the Pacific. These had an extra dual-purpose 4.5in gun, as the earlier ships proved to be under-armed. None of the second group was completed before the war's end.



Three 40mm anti-aircraft guns
Two 4.5in quick-firing guns in turret
Anchor

SUBMARINES

Submarines came into their own during World War I, and Germany, in particular, used them to excellent effect, especially against enemy merchant ships carrying vital supplies to Europe. During World War II, when Germany's surface fleet was severely limited by Hitler's prejudice against it, it was the "U-boats" that provided the Kriegsmarine with the bulk of its victories: it is a widely held view that they came close to bringing Britain to its knees. As a consequence, both Britain's Royal Navy and the US Navy were forced to make considerable investments in measures to combat the "submarine menace", which took some time to take effect. The Battle of the Atlantic could be fully declared won only after these measures had yielded results.


Bow torpedo tube
Conning tower
9

▲ U-9

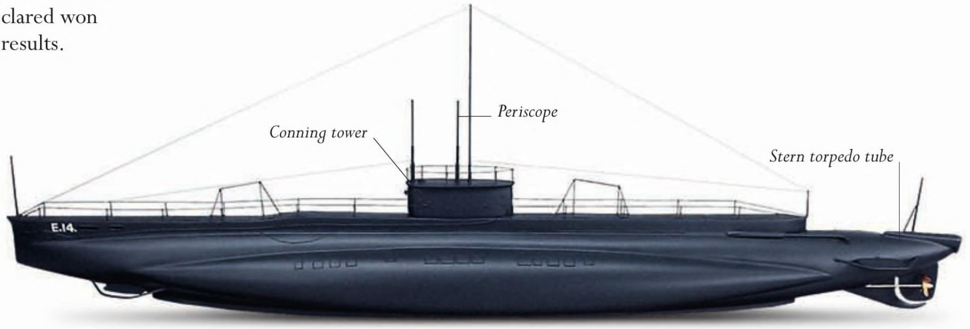
Commissioned 1910 **Origin** Germany

Displacement 495 tons (610 tons submerged)

Length 57.4m (188¼ft)

Top speed 14.2 knots (8 knots submerged)

The *U-9* was leader of a class of four Type U-9 coastal submarines constructed at the Danzig Navy Yard in the Baltic. Like all German submarines built prior to 1912, they had both electric motors and petrol engines. Though these were experimental boats, they also saw combat, and all but *U-9* were war losses.


Conning tower
Periscope
Stern torpedo tube
E.14.

▶ RN E-CLASS

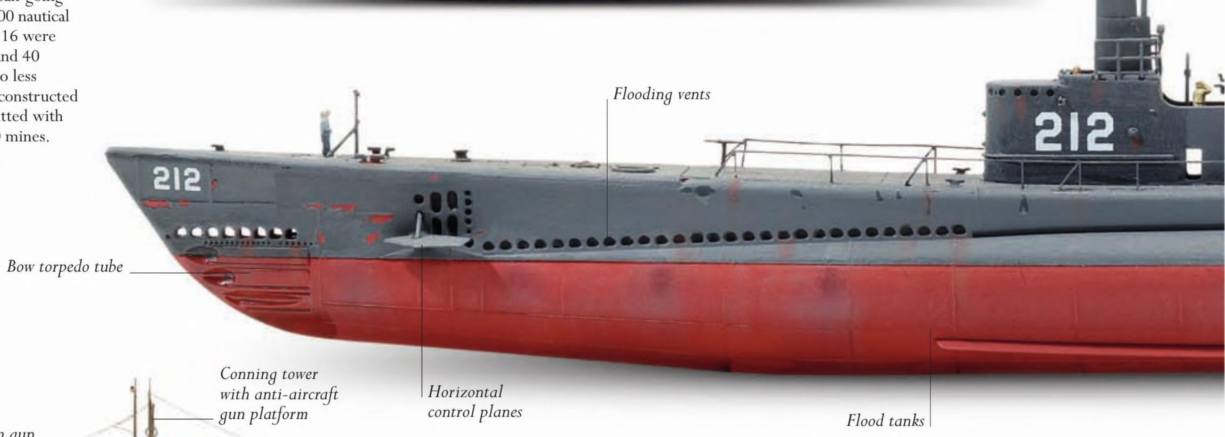
Commissioned 1913–17 **Origin** UK

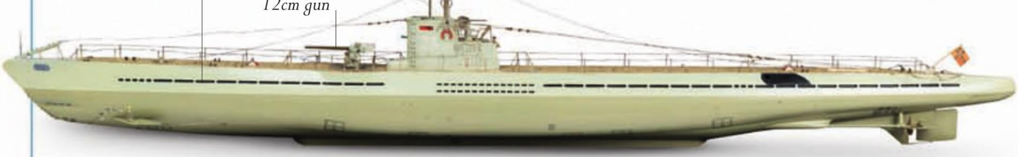
Displacement 670 tons (810 tons submerged)

Length 55.2m (181ft)

Top speed 15 knots (9 knots submerged)

Built in two groups, the British Royal Navy's *E*-class submarines were ocean-going boats with a range of 5,556km (3,000 nautical miles). At the outbreak of the war, 16 were in service or nearing completion, and 40 more were hastily constructed in no less than eight different yards. Six were constructed as minelayers; each of these were fitted with three torpedo tubes and carried 20 mines.


Flooding vents
212
212
Bow torpedo tube
Horizontal control planes
Flood tanks


Flooding vents
12cm gun
Conning tower with anti-aircraft gun platform

▲ U-25

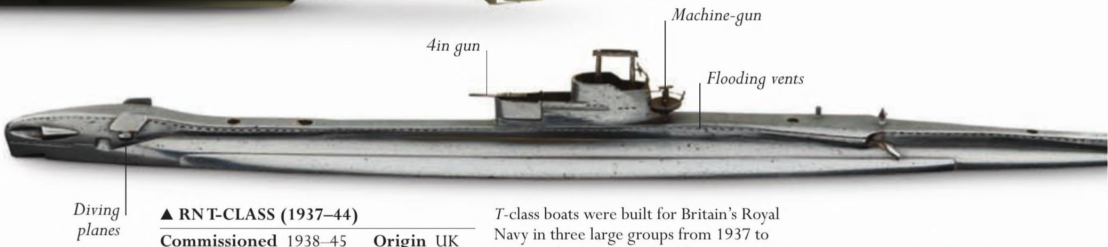
Commissioned 1936 **Origin** Germany

Displacement 860 tons (985 tons submerged)

Length 72.4m (237½ft)

Top speed 18.5 knots (8.3 knots submerged)

One of a pair of Type IA double-hulled ocean-going boats, the *U-25* was built by Deschimag for the Kriegsmarine in the mid-1930s, after a protracted and secretive design process. It sunk north of Terschelling, in August 1940, after hitting a mine that it had laid itself.


Machine-gun
4in gun
Flooding vents
Diving planes

▲ RN T-CLASS (1937–44)

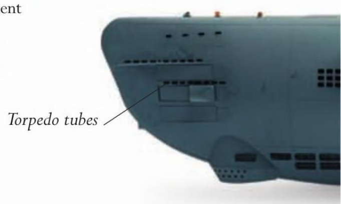
Commissioned 1938–45 **Origin** UK

Displacement 1,320 tons (1,575 tons submerged)

Length 83.8m (275ft)

Top speed 15.5 knots (9 knots submerged)

T-class boats were built for Britain's Royal Navy in three large groups from 1937 to 1944, undergoing considerable improvement in the process. Later builds remained in service until the 1960s. Maximum dive depth was 91m (300ft), which increased to 106m (350ft) in the last group.


Torpedo tubes

▼ GERMAN TYPE VIIC

Commissioned 1940–44

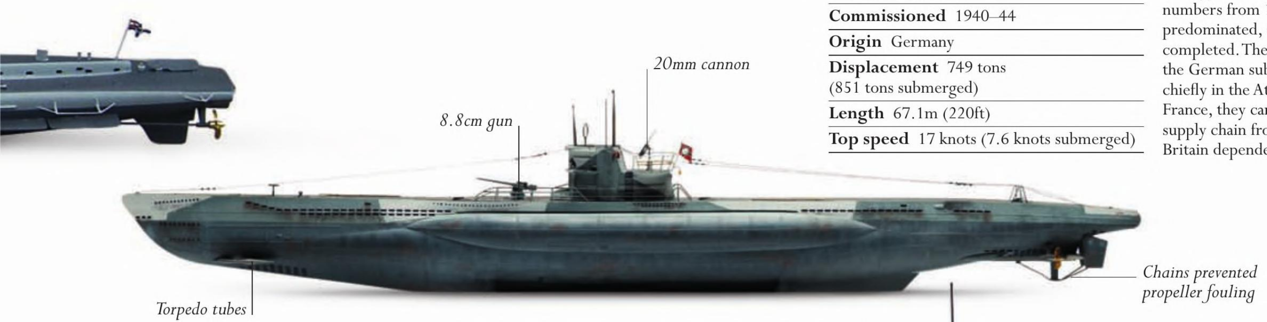
Origin Germany

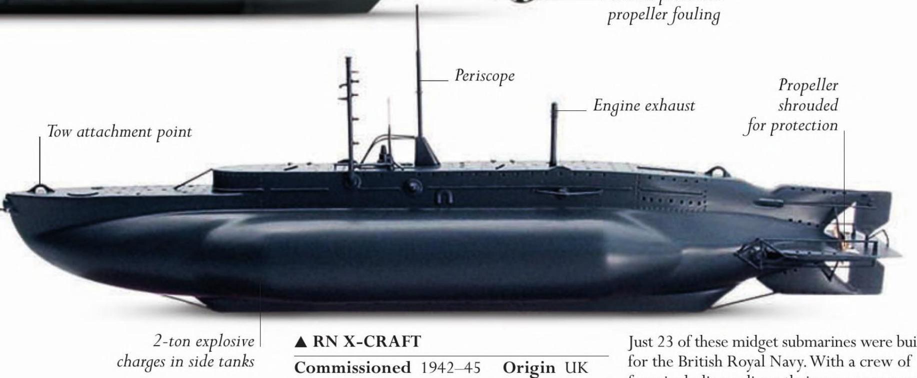
Displacement 749 tons (851 tons submerged)

Length 67.1m (220ft)

Top speed 17 knots (7.6 knots submerged)

The Type VII boats were built in very large numbers from 1936 to 1943. The VIICs predominated, and no less than 663 were completed. They were the workhorses of the German submarine service. Operating chiefly in the Atlantic from ports in western France, they came close to cutting the vital supply chain from North America on which Britain depended.


20mm cannon
8.8cm gun
Chains prevented propeller fouling
Torpedo tubes


Periscope
Engine exhaust
Propeller shrouded for protection
Tow attachment point
2-ton explosive charges in side tanks

▼ USS GATO

Commissioned 1941 **Origin** US

Displacement 1,810 tons (2,410 tons submerged)

Length 95m (311½ft)

Top speed 20 knots (8.75 knots submerged)

USS *Gato* was the leader of one of three near-identical classes of "fleet boats" that equipped the US Navy during World War II. Each class was modified extensively during and after the war. *Gato* itself survived as a training boat until the 1960s, but some in the class were transferred to other navies in the 1970s and remained in service until the 1990s.

▲ RN X-CRAFT

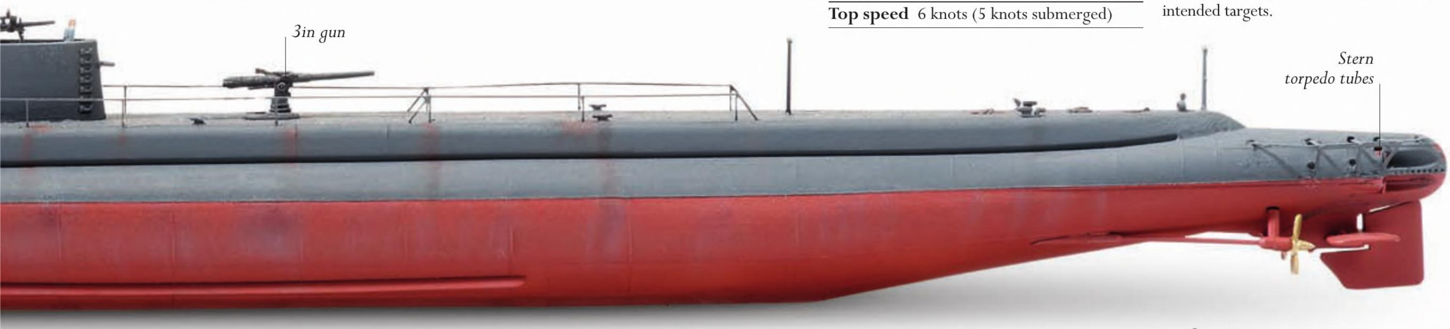
Commissioned 1942–45 **Origin** UK

Displacement 26.9 tons (29.7 tons submerged)

Length 15.7m (51½ft)

Top speed 6 knots (5 knots submerged)

Just 23 of these midget submarines were built for the British Royal Navy. With a crew of four, including a diver, their weapons were two 2-ton "side-charges" – mines carried along the sides of the hull – which were released to lie on the seabed below their intended targets.


3in gun
Stern torpedo tubes

▶ I-400

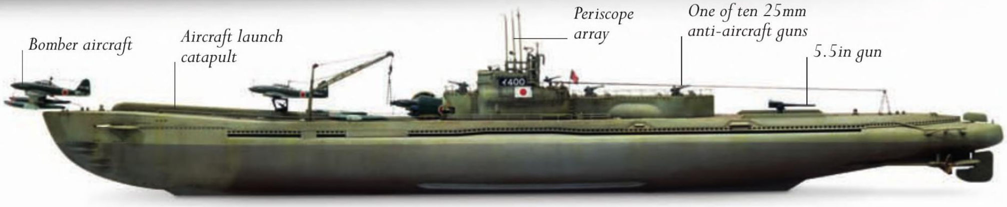
Commissioned 1944 **Origin** Japan

Displacement 5,225 tons (6,560 tons submerged)

Length 122m (410¼ft)

Top speed 18.7 knots (6.5 knots submerged)

The *Sen Toku* class consisted of submarine aircraft carriers built to launch airstrikes on the locks in the Panama Canal linking the Atlantic and the Pacific oceans. Eighteen were ordered, but just three were completed, one of which was converted into a tanker during construction. They were the largest submarines constructed until the US Navy's nuclear-powered *George Washington* class appeared in the 1960s.


Bomber aircraft
Aircraft launch catapult
Periscope array
One of ten 25mm anti-aircraft guns
5.5in gun

▼ WILHELM BAUER

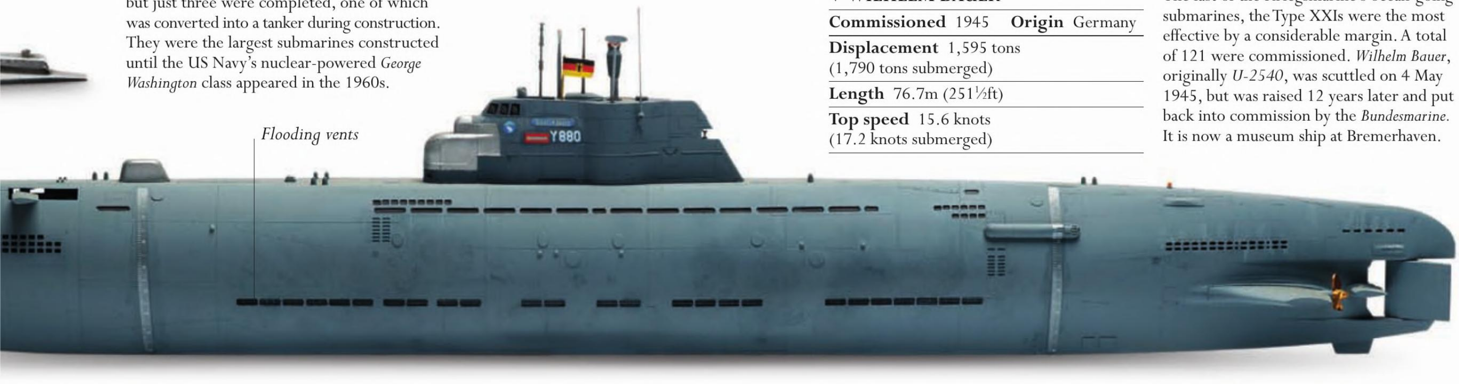
Commissioned 1945 **Origin** Germany

Displacement 1,595 tons (1,790 tons submerged)

Length 76.7m (251½ft)

Top speed 15.6 knots (17.2 knots submerged)

The last of the Kriegsmarine's ocean-going submarines, the Type XXIs were the most effective by a considerable margin. A total of 121 were commissioned. *Wilhelm Bauer*, originally *U-2540*, was scuttled on 4 May 1945, but was raised 12 years later and put back into commission by the *Bundesmarine*. It is now a museum ship at Bremerhaven.


Flooding vents
Y880

AMPHIBIOUS INVASION

THE NORMANDY LANDINGS

The Allied landings on Normandy beaches on D-day, 6 June 1944, comprised the largest amphibious operation ever. With around 160,000 soldiers put ashore in a single day despite heavy resistance, the invasion was a masterpiece of planning and organization on a vast scale.

The outcome of the Normandy landings depended upon experience accumulated by the Allies since the beginning of World War II – on Sicily and the Italian mainland, in the Dieppe Raid of 1942, and by US Marines in the Pacific. The most important lesson learned had been never to underestimate the difficulty of such an enterprise.

Successful landings required command of the air and sea, and the Allies achieved this on D-day. With most of the German Luftwaffe assigned to the Eastern front, or to homeland defence, Allied aerial dominance over the beaches was assured. Meanwhile, Allied navies deployed more than 1,200 warships for the invasion which, in combination with mines and air patrols, deterred attacks by German surface ships and submarines.

A second necessity for the landings was tactical surprise. The enemy knew an invasion was being prepared, but not where or when it would come, and deception operations made them expect an attack on the more obvious Pas-de-Calais. Poor weather in early June delayed this invasion by a day, but also put the defenders off their guard, since they believed landings would not be attempted in such conditions.

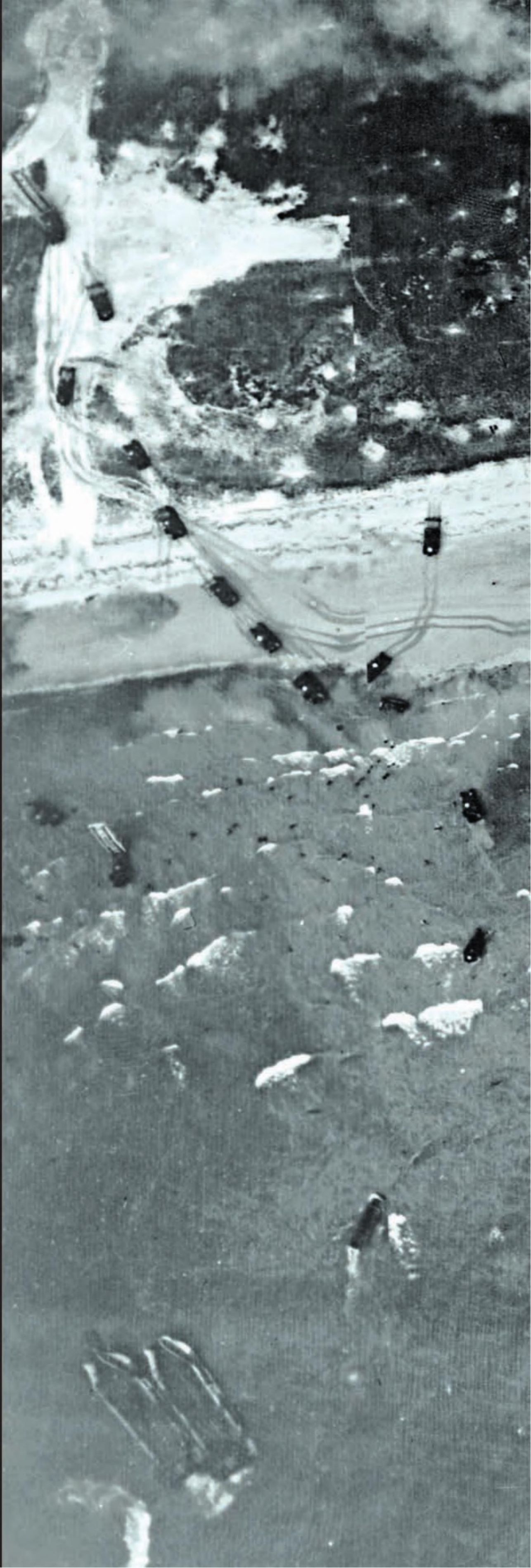
The five target beaches were codenamed Utah, Omaha, Gold, Juno, and Sword. Utah and Omaha were assigned to American troops, Gold and Sword to the British, and Juno to the Canadians. The invasion fleet set off from ports across the south of England on the night of 5–6 June, assembling south of the Isle of Wight. Minesweepers led the way across the English Channel, clearing a passage for other warships and troop transports, while airborne troops landed by parachute and glider to seize objectives behind the beaches. At dawn Allied warships, including six battleships, opened fire on the German Atlantic Wall coastal defences. This was the first warning the German defenders had of the impending invasion.

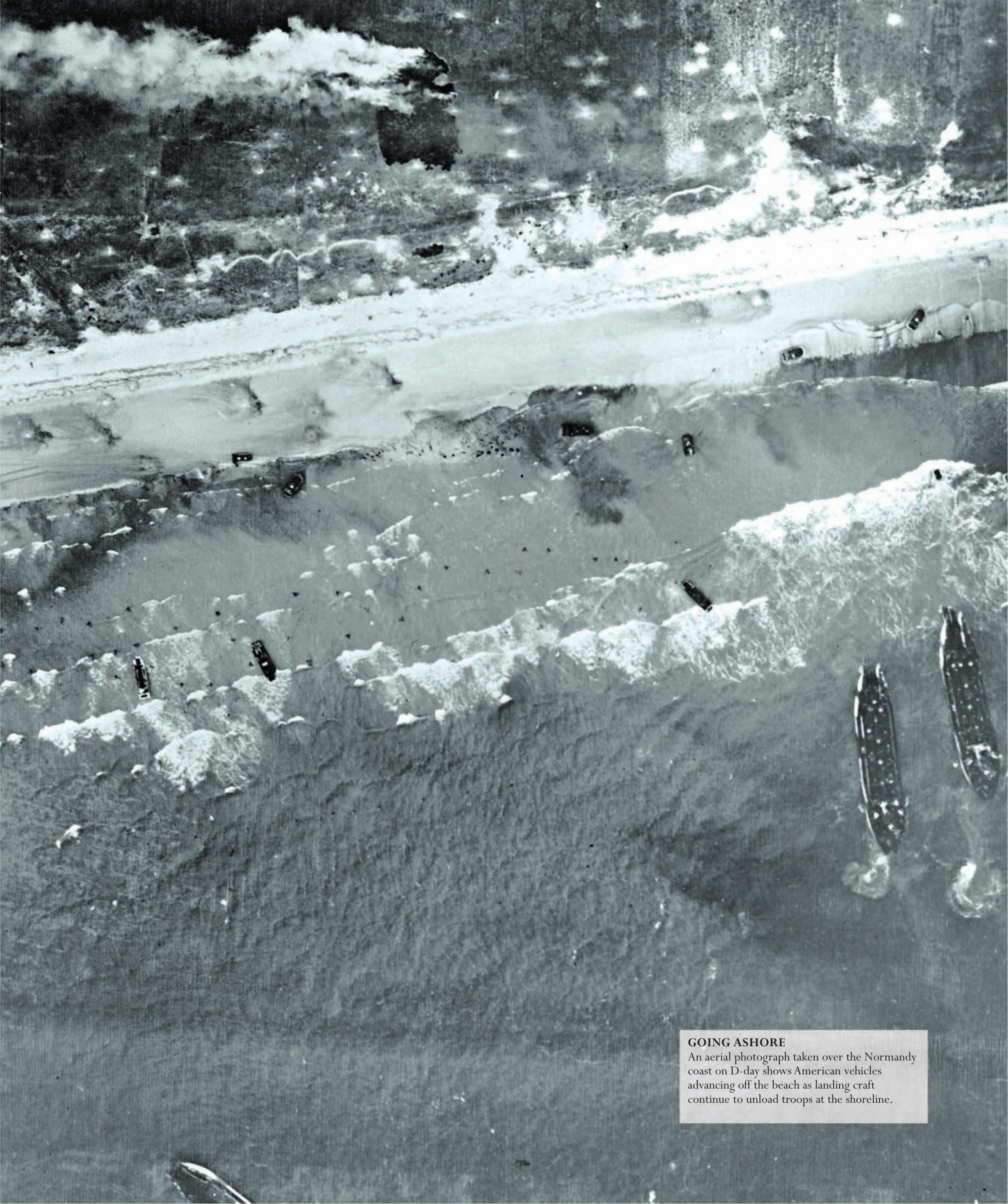
THE FINAL APPROACH

Allied soldiers transferred into more than 4,000 landing craft for the final approach. The craft were a mixture of flat-bottomed plywood Landing Craft, Vehicle, Personnels (LCVPs), Landing Craft Assaults (LCAs), and others, with ramps in the bow that lowered for the men to exit. Other specialized landing craft transported tanks or provided supporting fire.

Conditions were difficult. Tanks with floats designed to "swim" sank in the rough waters. Seasickness was rife, and on leaving the boats troops had to wade through deep water straight into enemy fire. Some soldiers who exited their crafts too far from shore drowned, dragged under by the weight of their equipment.

Despite losses of around 10,000 casualties, the landings succeeded, giving the Allies a foothold in occupied Europe. Only at Omaha beach were soldiers nearly driven back into the sea; many US tanks and engineers were lost before reaching shore, and defences were strong after inaccurate Allied bombing. Even there, with the help of well-directed naval gunfire, American troops established a secure beachhead by nightfall, and floating Mulberry harbours were towed into position to enable the troops ashore to receive supplies.





GOING ASHORE
An aerial photograph taken over the Normandy coast on D-day shows American vehicles advancing off the beach as landing craft continue to unload troops at the shoreline.

KEY **TACTIC**

KAMIKAZE

1944–45

In October 1944, Japan began to adopt suicide tactics, deliberately crashing their aircraft into American ships with the aim of crippling or sinking them. The kamikaze ("divine wind") units were initially made up of only elite flyers, but, by 1945, suicide attack had become a task for thousands of poorly trained novice pilots. An estimated 322 Allied ships were hit by kamikaze planes, and at least 34 of them sank.

▲ A Japanese Zero fighter seen just before it crashed into the USS *Missouri*, in 1945. The battleship suffered only superficial damage.

▶ **THE DIVE-BOMBER**
One of a new generation of high-performance American carrier aircraft introduced during World War II, the Curtiss SB2C Helldiver could bomb accurately enough to hit ships, unlike most conventional bombers.

KEY DEVELOPMENT

AIR AND SEA BATTLES

The growth of air power between 1914 and 1945 transformed naval warfare. Capable of deciding the outcome of battles with the long-range strike power of their aircraft, carriers took over from battleships as the most potent warships in a fleet.

▲ **THE FAIREY SWORDFISH**
The UK entered World War II with the outdated Fairey Swordfish biplane as its torpedo bomber. The slow-flying "Stringbag" was surprisingly effective, notably in an attack on the Italian fleet at Taranto in 1940.

Navies were at the forefront of the early development of military aviation. Naval commanders could see the advantages of aerial reconnaissance and were quick to experiment with both aeroplanes and airships when war broke out in 1914.

At first, seaplane tenders carried float aircraft, which were winched over the side to take off from the sea and – hopefully – recovered from the sea after returning from their mission. In 1916, the British Royal Navy began replacing seaplanes with wheeled landplanes. These might take off from a platform mounted on a warship's revolving gun turret or from a raft towed behind a destroyer. To land, these light, canvas-and-wood aircraft simply ditched into the sea, and were then hoisted aboard the ship.

In 1917, the British cruiser HMS *Furious* was fitted with a long flight deck, on which landing trials were carried out with a Sopwith Pup biplane. A converted ocean liner, HMS *Argus*, came closer to achieving a successful aircraft carrier design, recognizing the need to avoid

the turbulence created by a traditional ship's superstructure. The *Argus* was just entering service as World War I ended.

BETWEEN THE WARS

During the inter-war years there was impressive progress in the development of aircraft carriers in France, Japan, and the US, among others, despite the determination of some naval commanders to concentrate on battleships. The first purpose-built carriers appeared in the 1920s. British naval aviation was held back after the decision to give control of all military aircraft to their Royal Air Force. By 1939, when this unsatisfactory arrangement ended, the British Royal Navy had good-quality carriers, but its aircraft were obsolete. This allowed the US and Japan to take the lead in naval aviation.

▲ **A CROWDED FLIGHT DECK**
Taking off and landing aircraft on the deck of a carrier was a complex and accident-prone procedure under combat conditions. Here, Douglas SBD Dauntless dive-bombers form a line on the deck of USS *Yorktown*.

The US Navy followed the conversion of its USS *Lexington* and USS *Saratoga* battlecruisers, built 1920–27, with the purpose-built Yorktown class of carriers, introduced from 1937 onwards. Japan was especially successful in developing a carrier fleet, placing great importance on pilot training and the design of naval aircraft. It soon became apparent that dive-bombers and torpedo bombers were the best aircraft types for attacking enemy ships.

WAR IN THE PACIFIC

The early years of World War II repeatedly demonstrated that even the most heavily gunned warships were vulnerable to air attack. This was especially true in the Pacific War. The surprise attack mounted by a Japanese carrier task force on the US naval base at Pearl Harbor, Hawaii, in December 1941, was an unforgettable illustration of the devastating potential of naval air power, and forced American naval commanders to recognize that carriers were their capital ships. As a result, battleships, cruisers, and destroyers were given the role of protecting them.

The vast industrial capacity of the US helped to turn the tide. Carriers and naval aircraft were produced in astonishing quantity, enabling them to overwhelm and even eliminate the Japanese carrier fleet over the course of 1944. By 1945, the Allies had 40 carriers in their fleet off Okinawa, and the Americans had established themselves as undisputed world leaders in naval aviation.

> "The war would end with the **aircraft carriers** the fleet's **main striking force**"
>
> **BRITISH FLEET AIR ARM PILOT CHARLES LAMB**, *WAR IN A STRINGBAG*, 1977

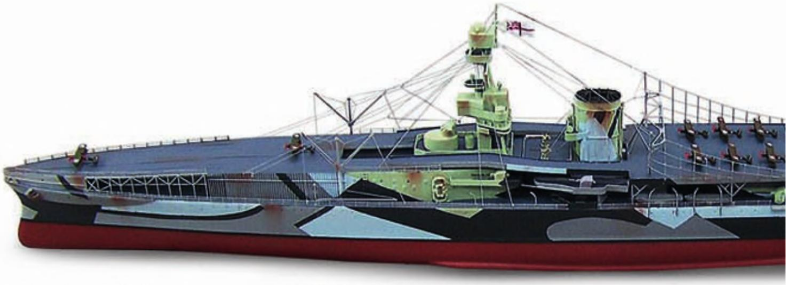
KEY **EVENTS**

1914–45

- **1914** Britain's Royal Naval Air Service attacks airship sheds at Cuxhaven, Germany, in the first sea-launched attack on a land target.
- **1922** The Japanese navy commissions *Hosho*, the first purpose-built aircraft carrier. Britain's HMS *Hermes*, which was laid down in 1918, is completed shortly after.
- **1941** Japanese carrier-borne aircraft attack the US naval base at Pearl Harbor, Hawaii, sinking or damaging 18 American ships.
- **1942** The Battle of Midway – a long-range duel between American and Japanese aircraft carriers – is fought in the mid-Pacific. The opposing fleets do not engage with their guns.
- **1943** The US Navy establishes a Fast Carrier Task Force to spearhead its Pacific campaign. The Task Force comprises a core of aircraft carriers escorted by big-gun warships.
- **1945** Japan's *Yamato*, the largest and most heavily armed battleship ever built, is sunk by American naval aircraft.

AIRCRAFT CARRIERS

The earliest aircraft-carrying ships actually functioned as floating seaplane bases. Although experimentation had taken place earlier, it was not until after World War I that true aircraft carriers, capable of launching aircraft and recovering them, entered service. By 1939, significant advances had been made, and the British Royal Navy had a dozen such carriers in operation or under construction. The Imperial Japanese Navy had a similar number, and the US Navy had eight. It was the US Navy that subsequently embraced the type most wholeheartedly, constructing huge numbers of "fleet" carriers, and lighter, less-capable "escort" carriers during the course of World War II. Many such escort carriers were also constructed in the US for the British Royal Navy.



▲ HMS FURIOUS

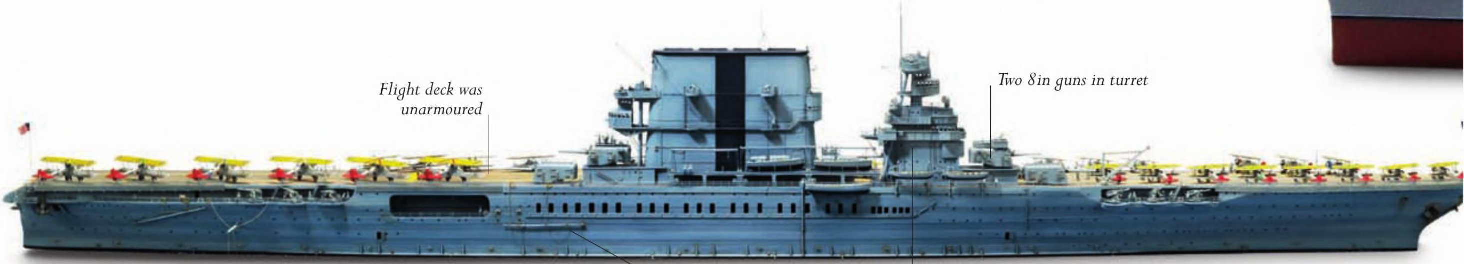
Commissioned 1917 **Origin** UK

Displacement 22,890 tons

Length 239.7m (786½ft)

Top speed 30 knots

Ordered as a light battlecruiser, *Furious* was completed as a makeshift aircraft carrier with a short flying-off deck forward. It was later completely reconstructed from the main deck upwards, and equipped to operate 36 aircraft. It served with distinction, almost unscathed, until September 1944.


Flight deck was unarmoured
Two 8in guns in turret
Hangar deck
Command bridge and flight operations control centre

▲ USS SARATOGA

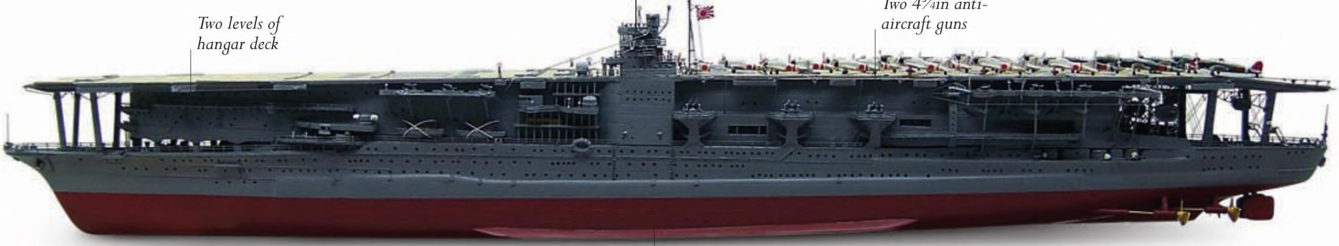
Commissioned 1927 **Origin** US

Displacement 43,055 tons

Length 270.7m (888ft)

Top speed 33 knots

Ordered as part of a group of six battlecruisers at the end of World War I, *Saratoga* and sister-ship *Lexington* were selected for completion as carriers. It became the US Navy's first effective carrier, and survived World War II, winning seven battle stars.


"Island" contained bridge and flight control
Two 4¾in anti-aircraft guns
Two levels of hangar deck
Hull had bulges to improve stability and give protection against torpedoes

▲ AKAGI

Commissioned 1927 **Origin** Japan

Displacement 42,750 tons

Length 260.7m (855½ft)

Top speed 31 knots

Akagi was completed as a carrier with a three-level flight deck, which allowed aircraft to take off from hangar-deck levels and land on the (truncated) upper deck. The boiler flues were on the starboard side, and an island was not fitted until *Akagi* was comprehensively rebuilt along more orthodox lines between 1935–38.

Armoured flight deck 3in thick
Armoured hangar deck

▼ HMS ARK ROYAL

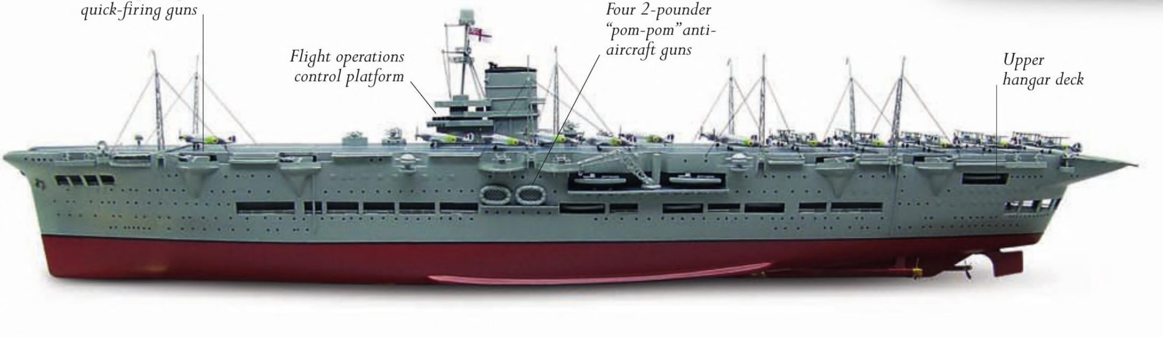
Commissioned 1938 **Origin** UK

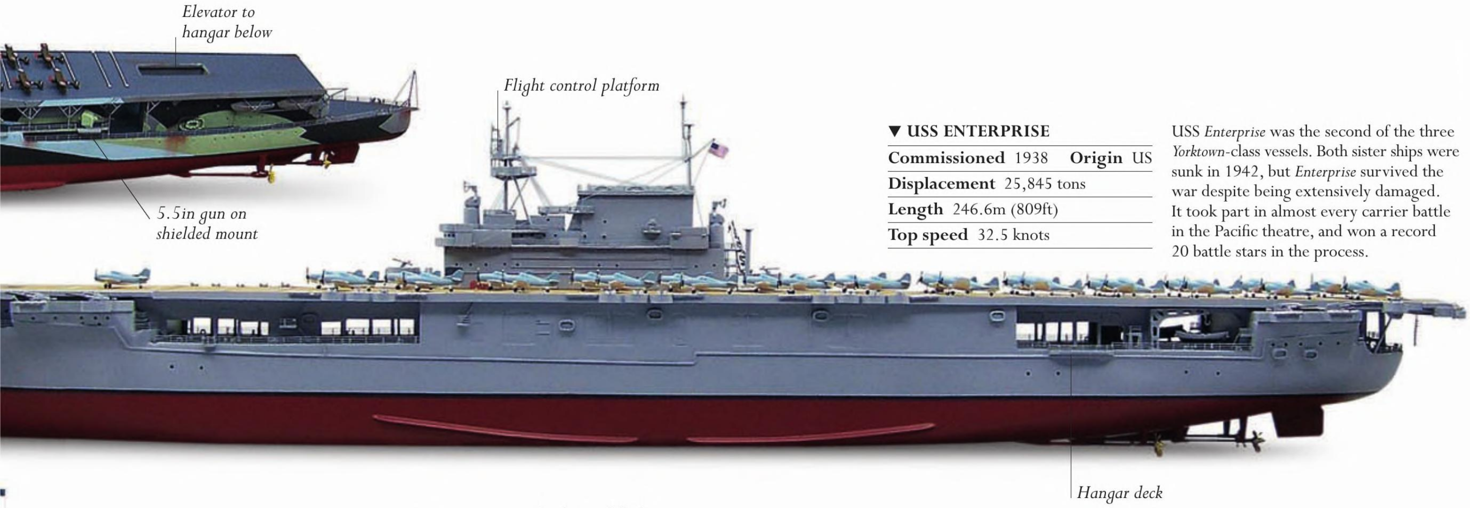
Displacement 27,720 tons

Length 243.8m (800ft)

Top speed 31 knots

The British Royal Navy's first large purpose-built aircraft carrier, *Ark Royal* introduced many design elements – including steam catapults – that were used in later types. Though well protected, it succumbed to a torpedo in the Mediterranean in 1941, having ferried much-needed aircraft to Malta.

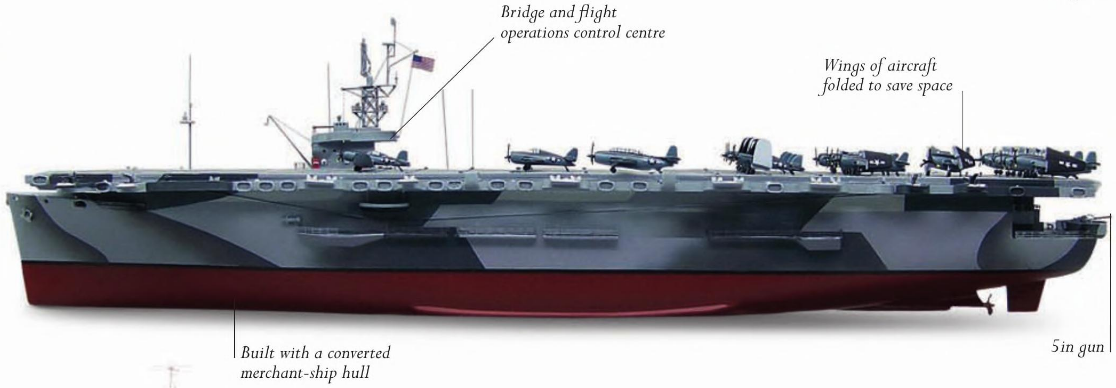

Two 4.5in high-angle quick-firing guns
Flight operations control platform
Four 2-pounder "pom-pom" anti-aircraft guns
Upper hangar deck


Elevator to hangar below
5.5in gun on shielded mount
Flight control platform
Hangar deck

▼ USS ENTERPRISE

Commissioned 1938 **Origin** US
Displacement 25,845 tons
Length 246.6m (809ft)
Top speed 32.5 knots

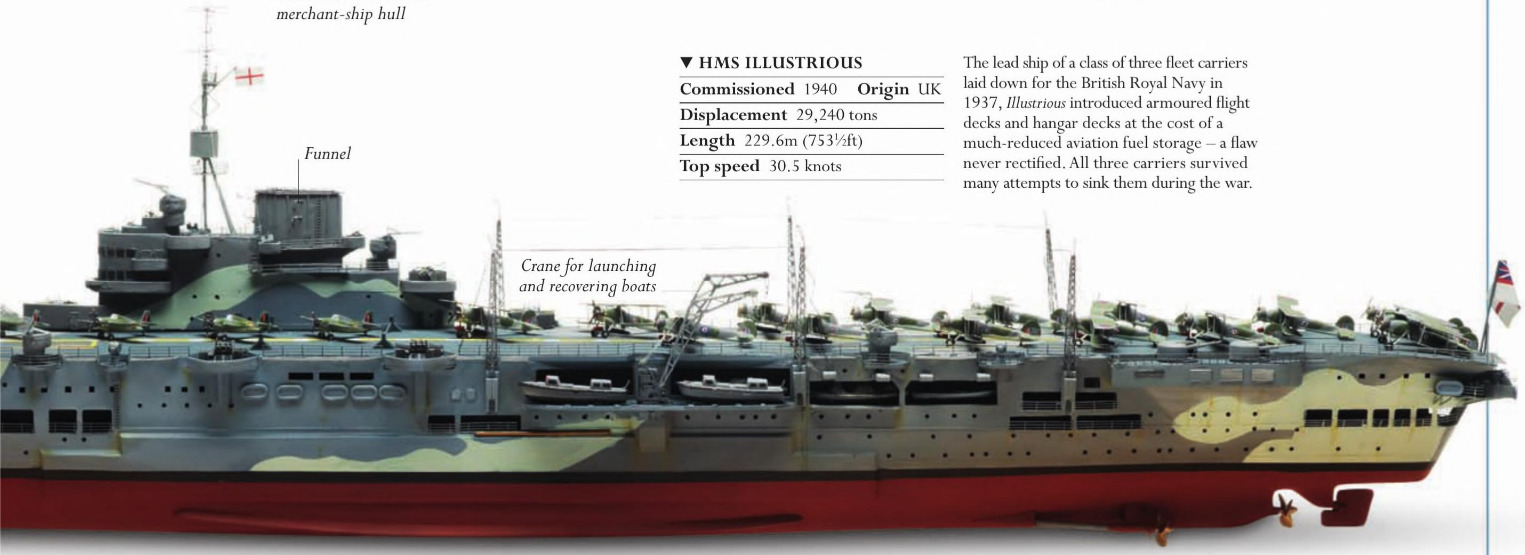
USS *Enterprise* was the second of the three *Yorktown*-class vessels. Both sister ships were sunk in 1942, but *Enterprise* survived the war despite being extensively damaged. It took part in almost every carrier battle in the Pacific theatre, and won a record 20 battle stars in the process.


Bridge and flight operations control centre
Wings of aircraft folded to save space
Built with a converted merchant-ship hull
5in gun

◀ USS GUADALCANAL

Commissioned 1943 **Origin** US
Displacement 10,900 tons
Length 156m (512¼ft)
Top speed 19 knots

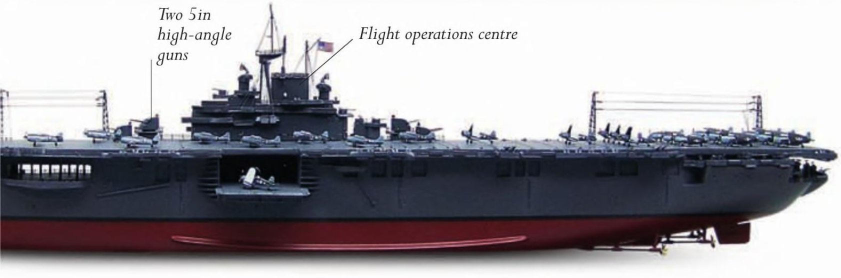
One of the 50-strong *Casablanca* class of escort carriers, *Guadalcanal* was built for the US Navy by Henry Kaiser, in Vancouver, Canada. His shipyard used production-line methods that saw ships being completed and entering service in less than four months.


Funnel
Crane for launching and recovering boats

▼ HMS ILLUSTRIOUS

Commissioned 1940 **Origin** UK
Displacement 29,240 tons
Length 229.6m (753½ft)
Top speed 30.5 knots

The lead ship of a class of three fleet carriers laid down for the British Royal Navy in 1937, *Illustrious* introduced armoured flight decks and hangar decks at the cost of a much-reduced aviation fuel storage – a flaw never rectified. All three carriers survived many attempts to sink them during the war.


Two 5in high-angle guns
Flight operations centre

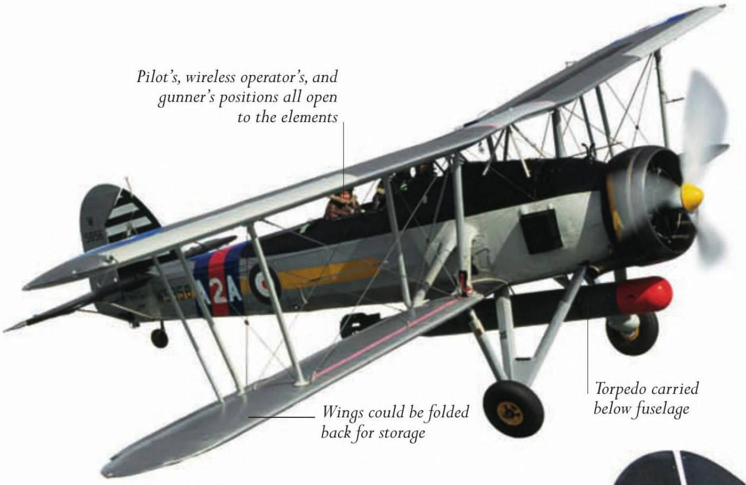
◀ USS ESSEX

Commissioned 1942 **Origin** US
Displacement 34,880 tons
Length 265.8m (872ft)
Top speed 32.7 knots

The 24 *Essex*-class fleet carriers at the core of the US Navy's Fast Carrier Task Force did more to win the war in the Pacific than any other ship. All survived, and – rebuilt with angled flight decks and other improvements – went on to form the basis of the post-war carrier fleet.

CARRIER AND MARITIME STRIKE AIRCRAFT

Initially, the planes borne on aircraft carriers were no different to those that operated from terrestrial fields, but, by the mid-1920s, deliveries of aircraft modified for shipboard performance had begun. From that point on, the designs of carrier- and land-based aircraft began to diverge, although the latter were still useable on ships. As well as fighters, whose primary role was to defend the mother ship and other ships in the fleet, long-range reconnaissance aircraft and specialist attack aircraft armed with torpedoes or bombs were also commissioned. The latter were dominated by dive bombers during this period.



Pilot's, wireless operator's, and gunner's positions all open to the elements

Wings could be folded back for storage

Torpedo carried below fuselage

▲ FAIREY SWORDFISH

Date 1936 **Origin** UK

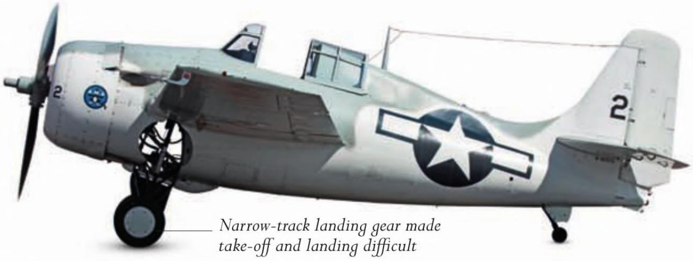
Wingspan 13.87m (45½ft)

Length 10.87m (35¾ft)

Top speed 225kph (140mph)

Engine 514.5kW (690hp) Bristol Pegasus IIIM.3 radial

Though considered obsolete even before the start of World War II, the "Stringbag" (so called because of wide variety of equipment it was cleared to carry) scored some notable successes, sinking an Italian battleship and damaging two more at Taranto in November 1940. Six months later a Swordfish disabled the German battleship *Bismarck*, allowing her to be sunk.



Narrow-track landing gear made take-off and landing difficult

▲ GRUMMAN F4F WILDCAT

Date 1940 **Origin** US

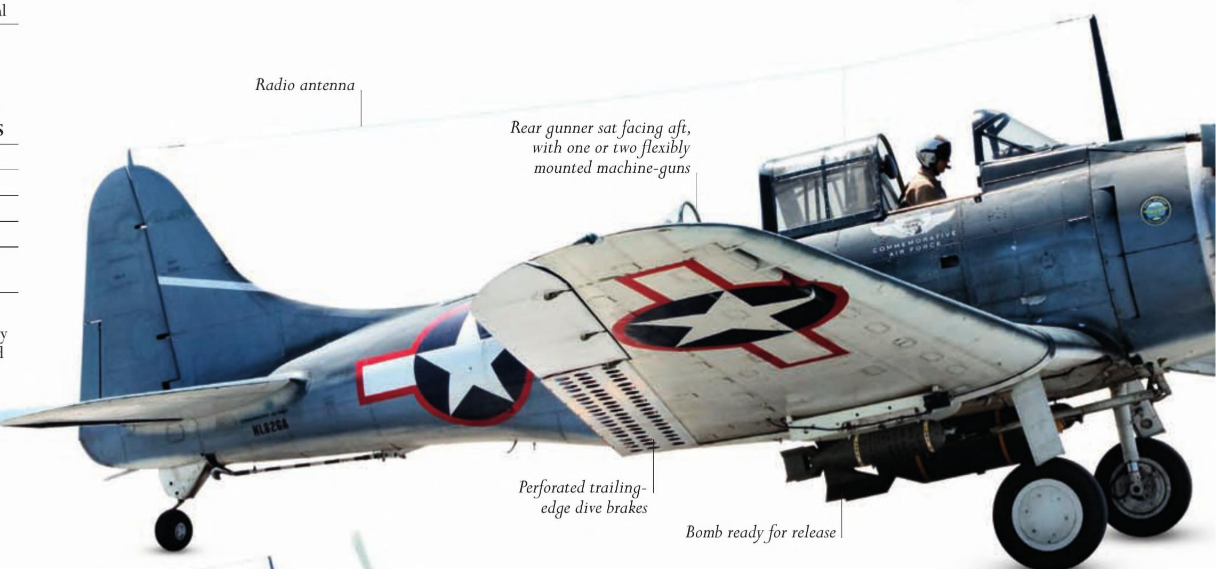
Wingspan 11.6m (38ft)

Length 8.8m (28¾ft)

Top speed 515kph (320mph)

Engine 895kW (1,200hp) Pratt & Whitney R-1830-86 Twin Wasp radial

When it came to developing a monoplane fighter, Grumman adapted the F3F biplane to create the F4F Wildcat, adding an improved tail and mid-mounted wing, and specifying a more powerful engine. Although capable, it was never a match for the Japanese Zero.



Radio antenna

Rear gunner sat facing aft, with one or two flexibly mounted machine-guns

Perforated trailing-edge dive brakes

Bomb ready for release

▶ DOUGLAS SBD DAUNTLESS

Date 1942 **Origin** US

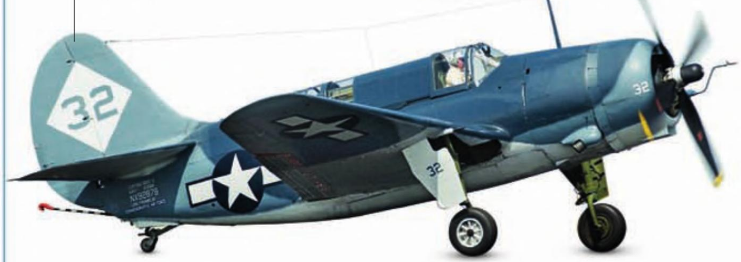
Wingspan 12.66m (41½ft)

Length 10.09m (33ft)

Top speed 410kph (255mph)

Engine 895kW (1,200hp) Wright R-1820-60 Cyclone radial

The "Slow But Deadly" (SBD) Dauntless was the US Navy's primary dive bomber until 1943. Rugged and dependable, it sank more Japanese ships than any other American aircraft, and later evolved into the A-1 Skyraider employed in Korea and Vietnam.



Large tail fin

◀ CURTISS SB2C HELLDIVER

Date 1943 **Origin** US

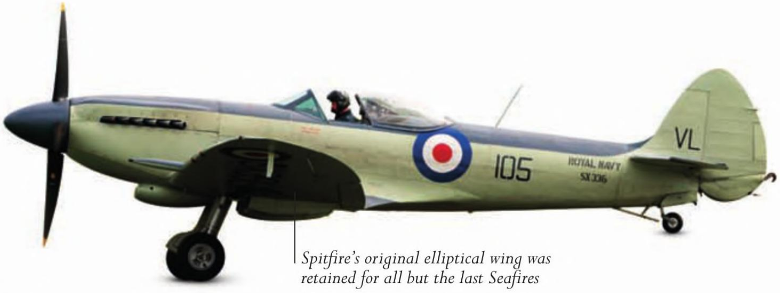
Wingspan 15.17m (49¾ft)

Length 11.81m (38¾ft)

Top speed 475kph (295mph)

Engine 1,416.8kW (1,900hp) Wright R-2600-20 Twin Cyclone radial

Intended as a replacement for the Dauntless, the Helldiver suffered from a vast number of design flaws that had to be corrected before it could enter service. It had poor handling characteristics, but it ended the war with an admirable combat record.



Spitfire's original elliptical wing was retained for all but the last Seafires

◄ SUPERMARINE SEAFIRE

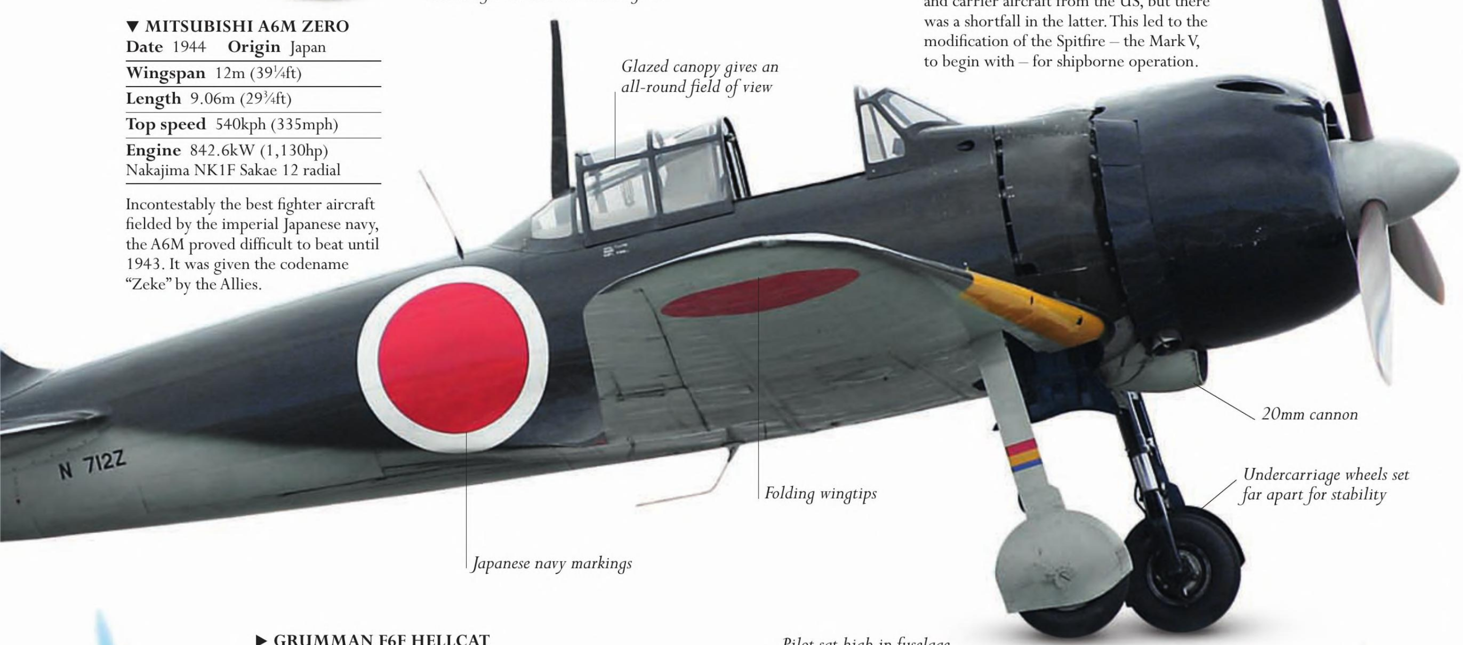
Date 1943 **Origin** UK
Wingspan 11.23m (36¾ft)
Length 9.62m (31½ft)
Top speed 630kph (391mph)
Engine 1,379.5kW (1,850hp) Rolls-Royce Griffon VI V-12

The UK received a large number of carriers and carrier aircraft from the US, but there was a shortfall in the latter. This led to the modification of the Spitfire – the Mark V, to begin with – for shipborne operation.

▼ MITSUBISHI A6M ZERO

Date 1944 **Origin** Japan
Wingspan 12m (39¼ft)
Length 9.06m (29¾ft)
Top speed 540kph (335mph)
Engine 842.6kW (1,130hp) Nakajima NK1F Sakae 12 radial

Incontestably the best fighter aircraft fielded by the imperial Japanese navy, the A6M proved difficult to beat until 1943. It was given the codename "Zeke" by the Allies.



Three-bladed constant-pitch propeller

Glazed canopy gives an all-round field of view

20mm cannon

Undercarriage wheels set far apart for stability

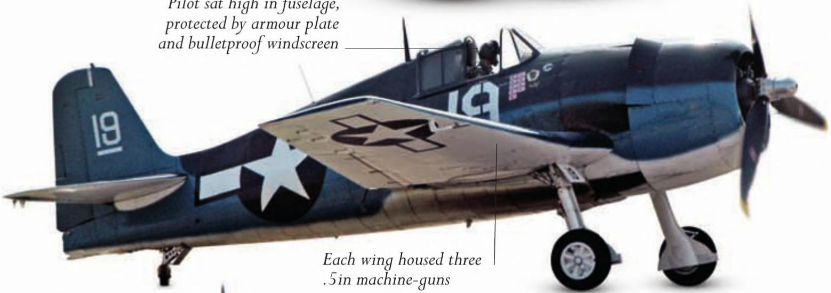
Folding wingtips

Japanese navy markings

► GRUMMAN F6F HELLCAT

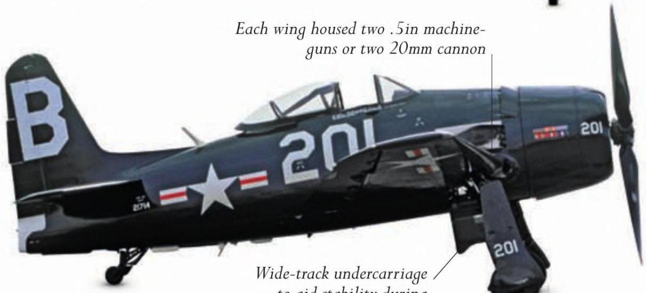
Date 1944 **Origin** US
Wingspan 13.06m (42¾ft)
Length 10.24m (33½ft)
Top speed 610kph (379mph)
Engine 1,640.5kW (2,200hp) Pratt & Whitney R-2800-10W Double Wasp radial

The Hellcat looked enough like the Wildcat to confuse the Japanese pilots it met, which was unfortunate for them as it was an entirely new design, with an extra 96.5kph (60mph) on its top speed and acceleration to match.



Pilot sat high in fuselage, protected by armour plate and bulletproof windscreen

Each wing housed three .5in machine-guns



Each wing housed two .5in machine-guns or two 20mm cannon

Wide-track undercarriage to aid stability during take-off and landing

◄ GRUMMAN F8F BEARCAT

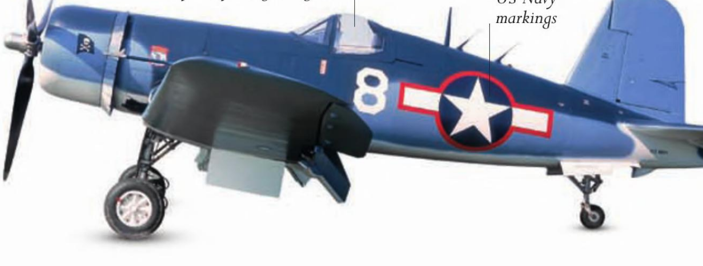
Date 1945 **Origin** US
Wingspan 10.92m (35¾ft)
Length 8.61m (28¼ft)
Top speed 680kph (422mph)
Engine 1,789.6kW (2,400hp) Pratt & Whitney R-2800-34W Double Wasp radial

The last of the World War II "Cats", the F8F was 20 per cent lighter than the F6F Hellcat, and even with the same power plant (engine) climbed 30 per cent faster and had an extra 64.3kph (40mph) on its top speed.

► VOUGHT F4U CORSAIR

Date 1942 **Origin** US
Wingspan 12.5m (41ft)
Length 10.1m (33ft)
Top speed 670kph (416mph)
Engine 1,491.3kW (2,000hp) Pratt & Whitney R-2800-8 radial

The Corsair was undoubtedly the most capable carrier-based fighter aircraft of World War II, and also gave very good service as a fighter-bomber. A total of 12,571 were produced between 1942 and 1953.



Cockpit set well back to improve pilot's field of view

US Navy markings

UNDER AIR ATTACK
A Japanese cruiser takes evasive action at the Battle of Leyte Gulf. The vulnerability of large warships to air strikes was a shock to all navies in World War II, requiring changes in tactics and making carriers the most important ships.

AIR–SEA COMBAT

THE BATTLE OF LEYTE GULF

The warfare between the Japanese Imperial Navy and the US Navy in the Pacific during World War II was remarkable for the significant role of aircraft and the epic scale of the combat. The Battle of Leyte Gulf in October 1944 was one of the largest sea battles ever fought.

By autumn 1944 Japanese naval aviation was a battered remnant of the force that had shocked the United States with its attack on Pearl Harbor almost three years earlier. Japan still possessed an impressive array of battleships and cruisers, but without adequate air cover, a sortie by these heavily gunned warships had become almost suicidal. Nonetheless, when the United States began amphibious landings on Leyte Island in the Japanese-occupied Philippines on 20 October, the Imperial Navy sent every available vessel to attack the landing force. The Japanese divided their striking forces in two, one sailing south of Leyte Island and the other to the north. Land-based aircraft on the Philippines would supply air cover, while Japan's few remaining carriers were used as a decoy. Without their aircraft they headed away from the action, in the hope that the carriers of Admiral William F. Halsey, Jr.'s Third Fleet would follow.

The Japanese southern force, including two battleships and four cruisers, was ambushed by Admiral Thomas Kinkaid's Seventh Fleet while attempting the passage of the Surigao Strait on the night of 24–25 October. American destroyers and PT boats first made torpedo runs, scoring a series of hits that sank the battleship *Fuso* with all hands. The Japanese then encountered the American main force of six battleships and eight cruisers, some equipped with advanced radar fire control that allowed them to hit Japanese warships at a range of over 18,280 metres (20,000 yards) in the dark. The second Japanese battleship, *Yamashiro*, was among the ships sunk by armour-piercing shells. Only a handful of crew survived.

Meanwhile, the approach of the other Japanese naval force through the Sibuyan Sea on 24 October had triggered a fierce air–sea battle. Halsey's carrier aircraft swarmed to attack the battleship *Musashi*, one of the largest, most powerfully gunned warships ever built. Hit by 19 bombs and 17 torpedoes in five successive air strikes, the massive ship sank with the loss of over 1,000 lives. Attacks by Japanese land-based aircraft inflicted some damage on US naval forces, but little in relation to their own losses of pilots and machines.

In the hope of at least dying to some effect, a group of Japanese pilots volunteered to carry out suicide attacks, crashing their aircraft into enemy ships. The first American ship sunk by kamikaze pilots was the escort carrier USS *St. Lo* on 25 October.

THE END OF AN ERA

The battle almost ended badly for the Americans. After the sinking of the *Musashi*, Halsey accepted the bait of the decoy Japanese carriers and pursued them to destruction. In the absence of the main American carrier force, Japanese heavy cruisers slipped through the San Bernadino Strait and surprised escort carriers and destroyers supporting the troop landings. The US Navy was briefly at the mercy of Japanese naval guns, but bold torpedo runs by the destroyers and attacks by aircraft from the escort carriers drove the Japanese off. Having lost three battleships, eight cruisers and four carriers, the Imperial Navy had fought its last major battle.

KEY DEVELOPMENT

TANKS AND INFANTRY IN WORLD WAR II

Land-based conflict in World War II extended across the globe, from the North African desert to the jungles of New Guinea and the streets of Berlin. Tanks and trucks made warfare more mobile, but did not eradicate the need for gruelling infantry combat.

▲ A SUITCASE RADIO
The British Mk III Suitcase Transceiver was designed for use by agents of Britain's Special Operations Executive (SOE) and resistance groups. All its components were miniaturized, although it still required valves, as transistors had not yet been invented.

Between the two World Wars, a number of army officers, including J F C Fuller in the UK, Heinz Guderian in Germany, and Mikhail Tukhachevsky in the Soviet Union, explored the use of tanks as the key strike force. Developments in tank design – improving speed, reliability, and armament – lent this vision credibility.

BLITZKREIG

Nazi Germany gave fullest rein to armoured war, and defeated Allied ground forces in France in May–June 1940. Using their *Blitzkreig* ("lightning war") tactics, German tanks and motorized infantry, supported by aircraft as "aerial artillery", broke through Allied lines in the Ardennes. Mobile radios solved the communication problems of World War I, allowing generals to keep in touch with advancing forces, and facilitating combined ground and air manoeuvres. As the war progressed, countermeasures were introduced, including mines, anti-tank guns, and infantry anti-tank weapons. The development of self-propelled guns provided artillery support for mobile forces, and also gave extra firepower to destroy advancing tanks.

Most infantry entered the war with the same bolt-action rifles issued in World War I, although the US Army had adopted the semi-automatic M1 Garand in 1936. By the end of the war, German

▶ TANK WARFARE
Following variable battlefield performance in World War I, the tank became a crucial part of land forces in World War II, both for Allied and Axis armies.

KEY **FIGURE**

GENERAL PATTON

1885–1945

George S Patton first commanded tanks during World War I. During World War II, he became America's most aggressive practitioner of armoured warfare, from North Africa and Sicily, to the spectacular dash across France in the summer of 1944. He excelled in defeating a desperate, final counter-offensive by the Germans in the Ardennes, in the winter of 1944–45.

▲ Patton was a controversial commander, often feared as well as respected.

troops had the Sturmgewehr, the first assault rifle. Heavy, general-purpose, and light machine-guns were ubiquitous, as were submachine-guns, including the British Sten and the American Thompson ("Tommy") gun. Cavalry were mostly absent, although some armies still used horse-drawn supply trains – Germany assembled over 600,000 horses for its 1941 invasion of the Soviet Union.

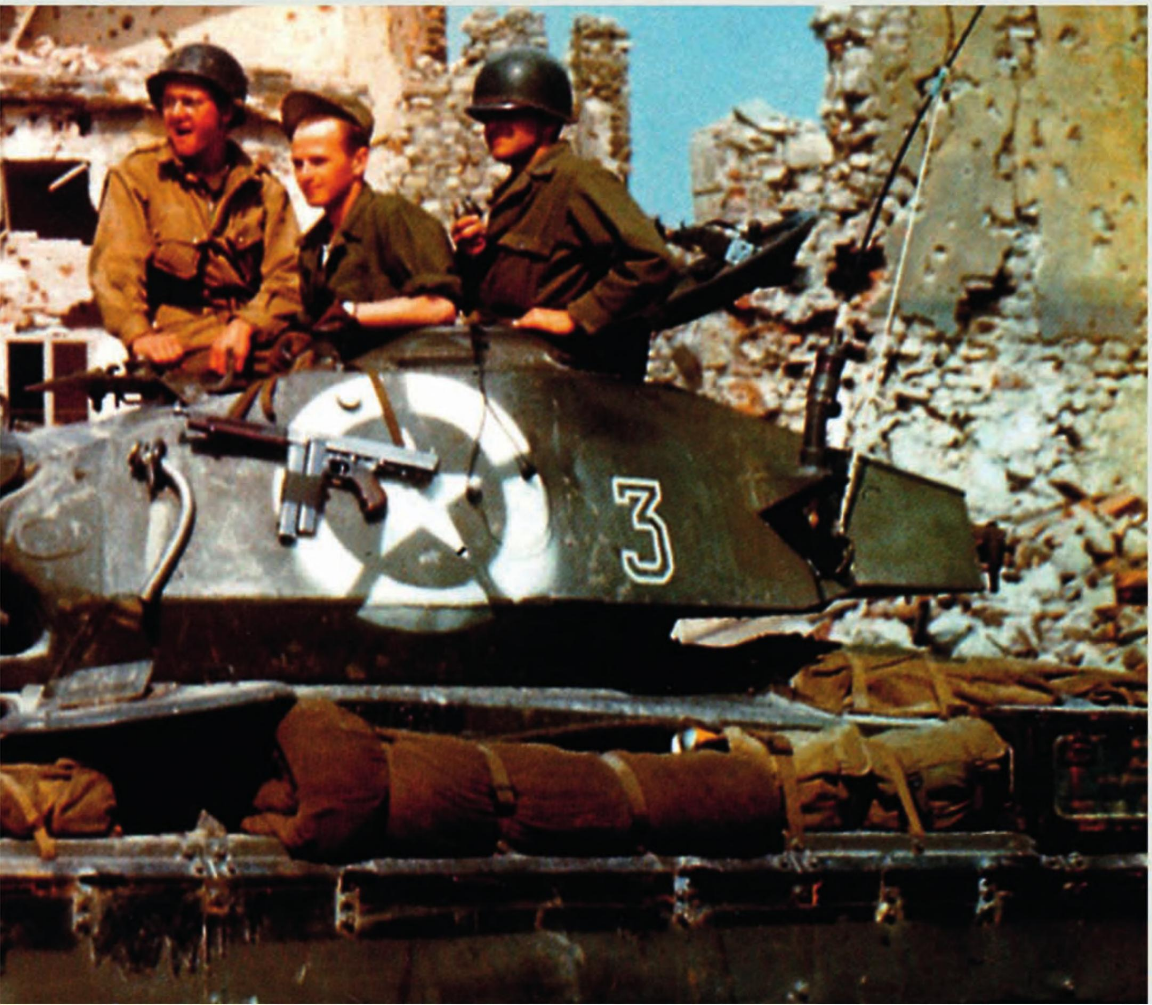
TACTICS AND FORCES

Airborne troops emerged as a new elite branch of infantry, delivered to battle by parachute or glider. The Allies also conducted amphibious operations on a massive scale – particularly the US Marines in their "island-hopping" campaign against the Japanese in the Pacific. Resistance groups mounted guerrilla warfare in occupied territory, and irregular forces fought behind enemy lines.

However, land warfare in World War II was not only about mobility; infantry fought at close quarters for long periods at Stalingrad in the Soviet Union in 1942–43, and on Iwo Jima in the Pacific in 1945. Often, defensive positions were attacked by artillery barrage and infantry assault, supported with armoured vehicles – similar tactics, albeit with improved technology, to those used in World War I.

> "The real secret is speed – **speed of attack** through **speed of communication**"
>
> **GENERAL ERHARD MILCH**, DISCUSSING *BLITZKRIEG*, 1939

◀ **US MARINES ON GUADALCANAL**
World War II soldiers had to fight in a wide variety of environments. The Pacific island of Guadalcanal, the scene of intense combat between American and Japanese troops in 1942, was difficult jungle terrain.



KEY **EVENTS**

1919–45

- **1919** British Army officer J F C Fuller presents a plan for offensives based on penetration in depth by a strike force of massed tanks, supported by aircraft and motorized infantry battalions.
- **1928** American engineer J Walter Christie completes his design for a high-speed tank with a revolutionary suspension system.
- **1936** The US Army adopts the semi-automatic M1 Garand rifle, with an eight-round "en-bloc" clip (with cartridges and clip inserted in a fixed magazine) – a significant advance on existing bolt-action rifles.
- **May–June 1940** German *Blitzkrieg* tactics combine tanks, aircraft, and motorized infantry to break deep into enemy territory.
- **May 1941** An invading force of German paratroopers land on Crete.
- **July 1943** Massed German tanks are defeated at the Battle of Kursk by Soviet defences, including minefields and anti-tank guns.
- **1945** American troops make extensive use of flamethrowers on Iwo Jima and Okinawa.

ALLIED ARMOURED FIGHTING VEHICLES

Although Allied tanks seldom reached the standard of their German counterparts in terms of technical excellence, they were far better equipped to meet the demands of mass production. This was especially the case with the Soviet T-34/85 and the US M4 Sherman tanks, which were manufactured in tens of thousands and played a pivotal role in defeating the Germans on both the Eastern and Western fronts. France produced some good tank designs in the 1930s, but failed to use them effectively when Germany invaded France in 1940. British tanks often proved inadequate for combat conditions, although the up-gunned Sherman Firefly proved to be a potent battle-winning weapon.

▼ CHAR B1-BIS HEAVY TANK

Date 1936 **Origin** France

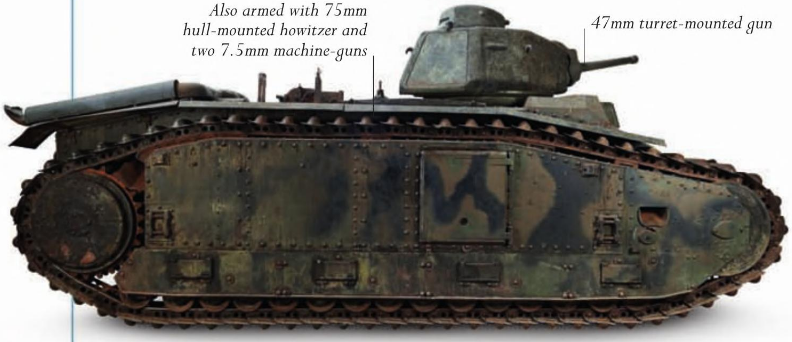
Weight 28 tonnes (30.8 tons)

Length 6.37m (20¾ft)

Top speed 28kph (17mph)

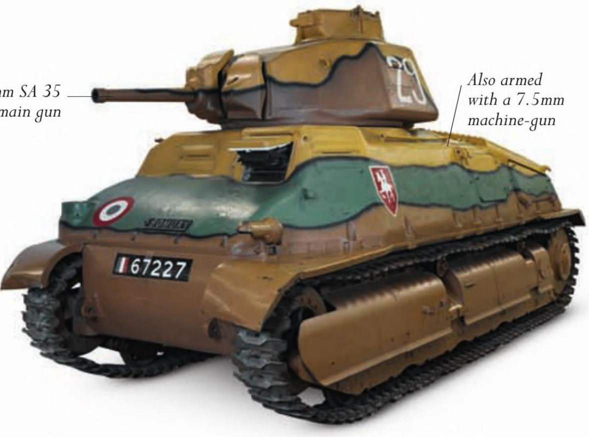
Engine Renault 6-cylinder 229kW (307hp) petrol engine

The French army's B1-bis was a formidable tank in its day, even if it was slow and not very reliable. Heavily armoured, it had the unusual distinction of being equipped with two main armaments – a howitzer for firing high explosives against enemy fortifications, and a turret-mounted anti-tank gun.



Also armed with 75mm hull-mounted howitzer and two 7.5mm machine-guns

47mm turret-mounted gun



47mm SA 35 main gun

Also armed with a 7.5mm machine-gun

▲ SOMUA S35

Date 1936 **Origin** France

Weight 19.5 tonnes (21.5 tons)

Length 5.38m (18ft)

Top speed 40kph (25mph)

Engine SOMUA 8-cylinder 142kW (190hp) petrol engine

An effective 1930s design that utilized a powerful main gun and a cleverly sloped armour, the three-man SOMUA equipped France's cavalry divisions, complementing the infantry's Char B1-bis. One drawback, however, was that the commander was also required to act as the gunner inside the very cramped turret.

▶ M4A1 MEDIUM TANK (SHERMAN)

Date 1941 **Origin** US

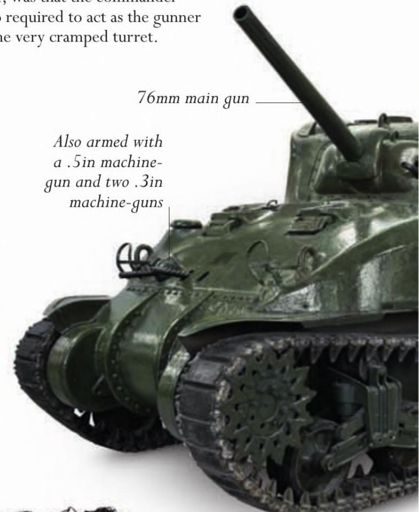
Weight 32.3 tonnes (35.6 tons)

Length 5.84m (19ft)

Top speed 48kph (30mph)

Engine Continental R975 298kW (400hp) petrol radial engine

The M4 tank was the most important tank fielded by the Western Allies, equipping the armoured divisions of the US and UK. Although easy to produce and maintain, it was inadequately armoured and its gun could not take on the Panther and Tiger tanks of the German armed forces.



76mm main gun

Also armed with a .5in machine-gun and two .3in machine-guns

▼ CRUISER MK VIII (A27M) CROMWELL TANK

Date 1943 **Origin** UK

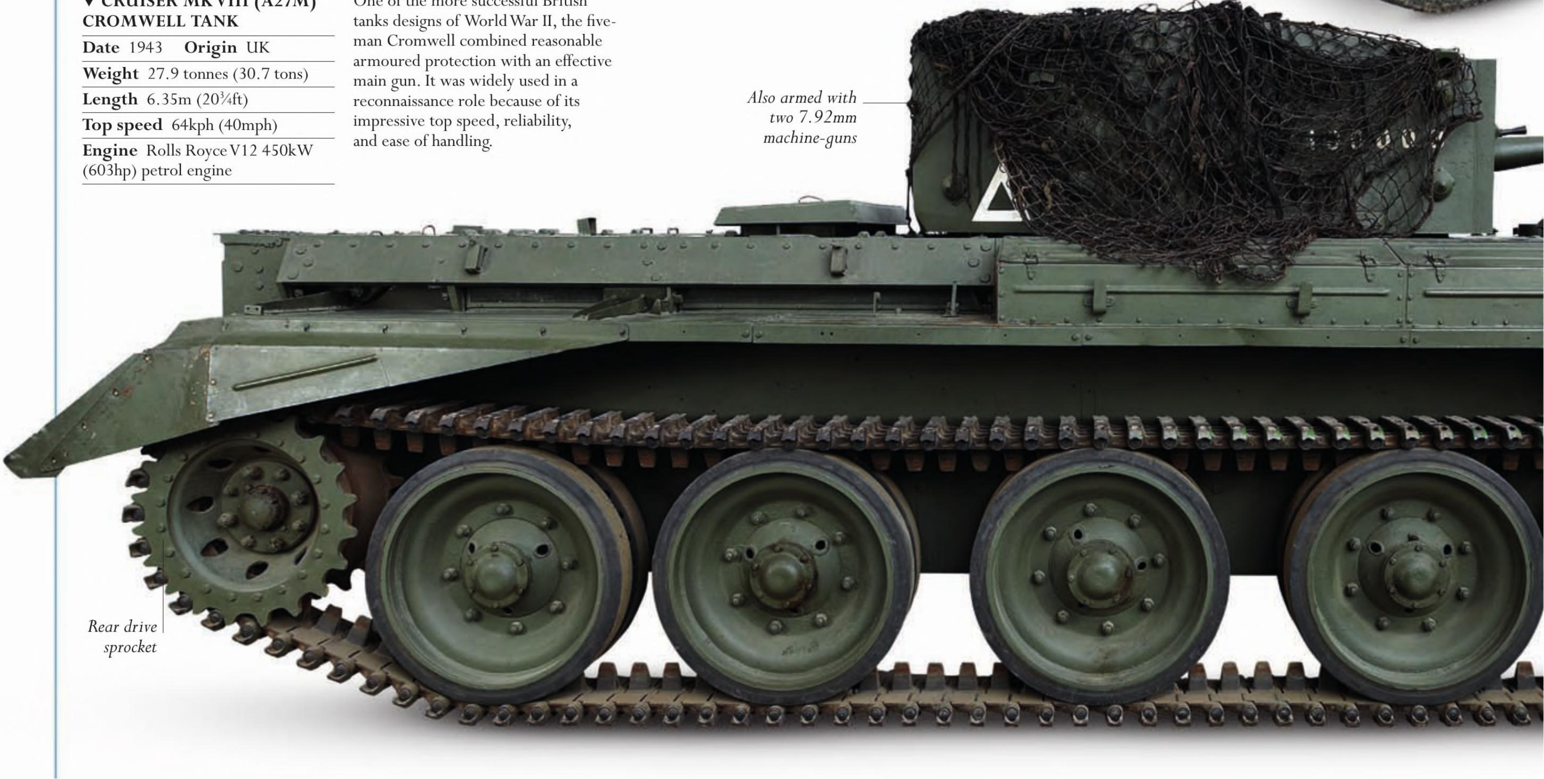
Weight 27.9 tonnes (30.7 tons)

Length 6.35m (20¼ft)

Top speed 64kph (40mph)

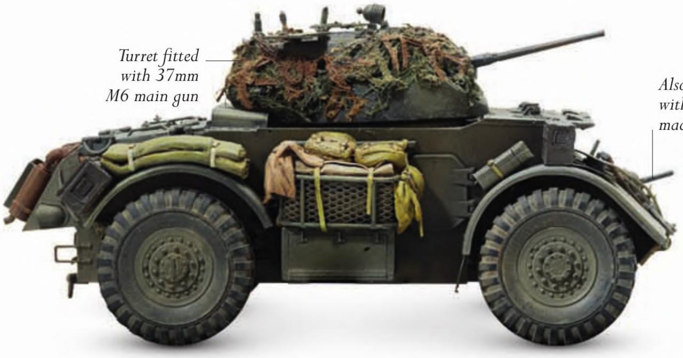
Engine Rolls Royce V12 450kW (603hp) petrol engine

One of the more successful British tanks designs of World War II, the five-man Cromwell combined reasonable armoured protection with an effective main gun. It was widely used in a reconnaissance role because of its impressive top speed, reliability, and ease of handling.



Also armed with two 7.92mm machine-guns

Rear drive sprocket


Turret fitted with 37mm M6 main gun
Also armed with two .3in machine-guns

▲ T17E1 STAGHOUND LIGHT ARMOURED CAR

Date 1943 **Origin** US

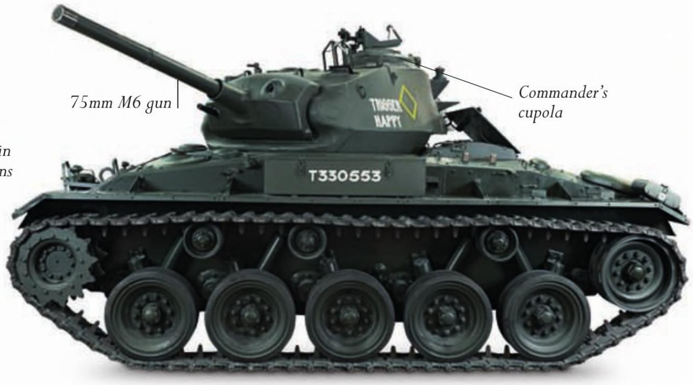
Weight 13.9 tonnes (15.3 tons)

Length 5.49m (18ft)

Top speed 89kph (55mph)

Engine Two GMC 270 6-cylinder 72kW (97hp) petrol engines

Although designed and built in the US, the Staghound was used almost exclusively by British and Commonwealth forces. Reliable and popular with its crew, a number of variants were developed, which included a close-support version armed with a 75mm howitzer, and an anti-aircraft version with two .5in Browning machine-guns. It was operated by a crew of five.


75mm M6 gun
Commander's cupola
TRIGGER HAPPY
T330553

▲ M24 CHAFEE LIGHT TANK

Date 1944 **Origin** US

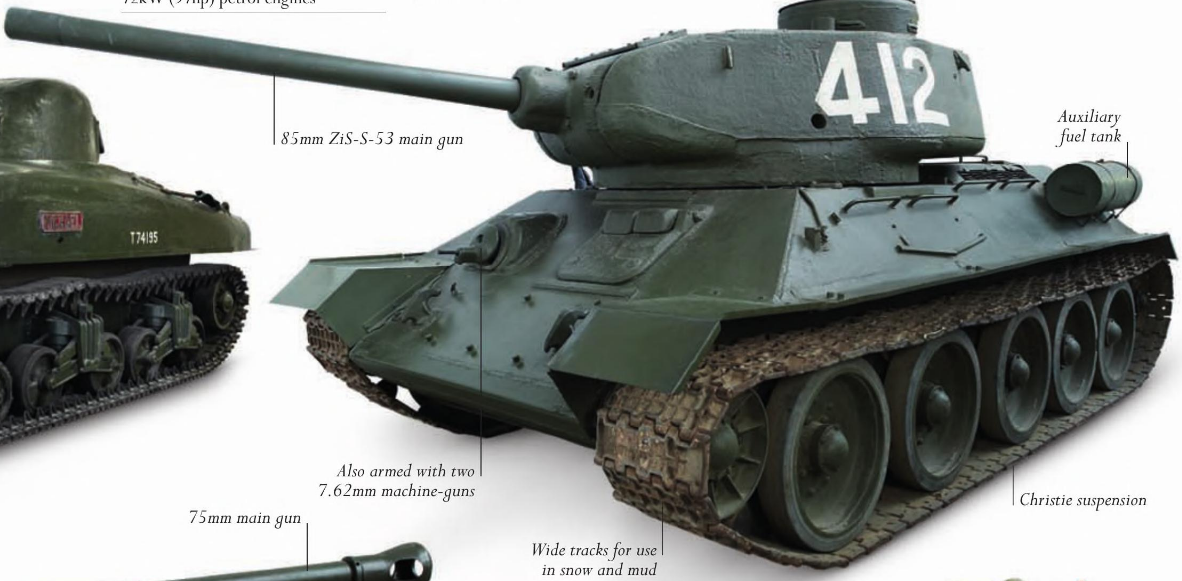
Weight 18.4 tonnes (20.2 tons)

Length 4.99m (16¼ft)

Top speed 56kph (35mph)

Engine Two Cadillac M44T24 82kW (110hp) engines

The US Army's requirement for a light tank with a more powerful armament than the standard 37mm gun led to the introduction of the M24 with a 75mm gun. Reliable and swift, it was a popular armoured fighting vehicle, operating with a crew of five. However, it only arrived at the front line in Europe during the closing stages of World War II.


412
85mm ZiS-S-53 main gun
Auxiliary fuel tank
Also armed with two 7.62mm machine-guns
Wide tracks for use in snow and mud
Christie suspension

◀ T-34/85 MEDIUM TANK

Date 1944 **Origin** Soviet Union

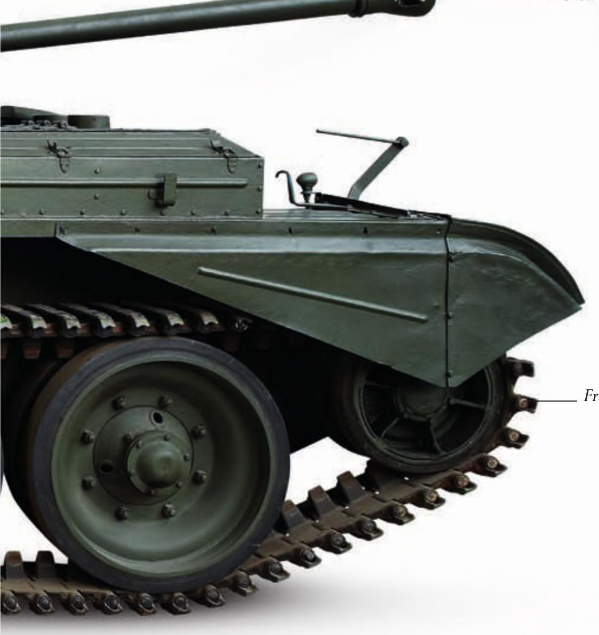
Weight 32 tonnes (35.3 tons)

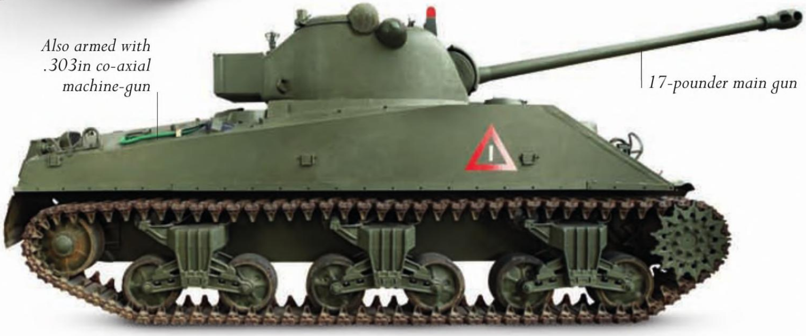
Length 6.68m (22ft)

Top speed 50kph (31mph)

Engine 12-cylinder 370kW (496hp) diesel engine

The T-34/85 represented a superb combination of firepower, armour protection, and mobility. When the Germans first encountered the T-34/85 in 1941, armed with the smaller 76.2mm gun, they realized they were facing a tank far superior to anything they could field. Even after the development of a new range of German tanks, it remained a formidable armoured fighting vehicle.


75mm main gun
Front idler


Also armed with .303in co-axial machine-gun
17-pounder main gun

▲ M4 MEDIUM TANK (SHERMAN FIREFLY)

Date 1944 **Origin** US/UK

Weight 33 tonnes (36.4 tons)

Length 5.89m (19¼ft)

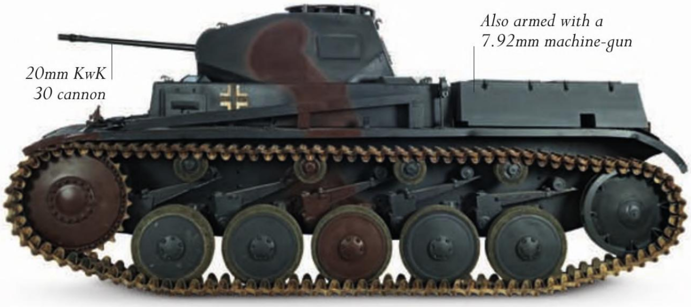
Top speed 40kph (25mph)

Engine Chrysler 317kW (425hp) multibank engine

The lack of a powerful main gun hampered the standard M4 tank, but this was rectified by the introduction of a British 17-pounder main armament in the Firefly. This high-velocity gun was capable of taking on German heavy tanks, although the tank's light armour remained inadequate for operations in Northwest Europe in 1944–45.

AXIS ARMOURED FIGHTING VEHICLES

As the nation that developed the concept of *Blitzkrieg*, it was hardly surprising that Germany should develop some of the most advanced and effective armoured fighting vehicles (AFVs) of World War II. The Panther and Tiger tanks struck fear in their Allied opponents, but, unlike the Allies, German tank manufacturers could not utilize the methods of mass production, as their vehicles were slow and expensive to build. Germany's Axis partners, Italy and Japan, produced some effective designs in the 1930s, but were unable to develop them further as the war progressed.



20mm KwK 30 cannon

Also armed with a 7.92mm machine-gun

▲ PANZERKAMPFWAGEN II LIGHT TANK, AUSF F

Date 1935 **Origin** Germany

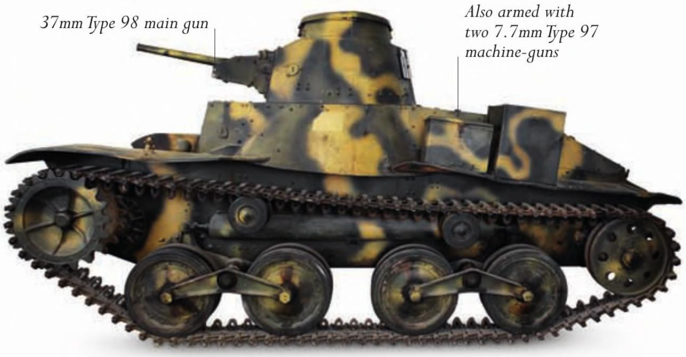
Weight 10 tonnes (11 tons)

Length 4.64m (15¼ft)

Top speed 55kph (34mph)

Engine Maybach 6-cylinder 104kW (140hp) petrol engine

The Panzer II, manned by a crew of three, was originally created to function as a training tank. However, the shortage of more powerful models brought it into the front line, where it was used in huge numbers for the invasions of Poland and France.



37mm Type 98 main gun

Also armed with two 7.7mm Type 97 machine-guns

▲ TYPE 95 HA-GO LIGHT TANK

Date 1936 **Origin** Japan

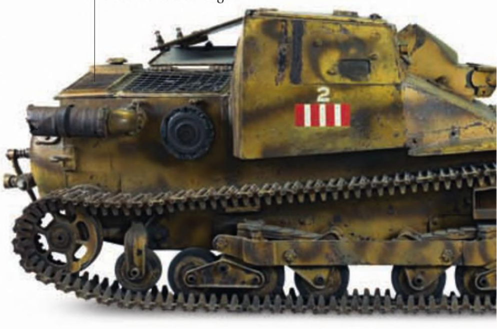
Weight 7.4 tonnes (8.1 tons)

Length 4.38m (14¼ft)

Top speed 45kph (28mph)

Engine Mitsubishi NVD 6120 6-cylinder 89kW (120hp) diesel engine

Entering service in the 1930s, this three-man tank was typical of its time. While it proved successful during the war in China, it was outclassed by US armour and anti-tank guns during World War II.



Also armed with 6.5mm machine-gun

▶ CARRO VELOCE L3-33 FLAMETHROWER

Date 1936 **Origin** Italy

Weight 3.2 tonnes (3.5 tons)

Length 3.17m (10½ft)

Top speed 42kph (26mph)

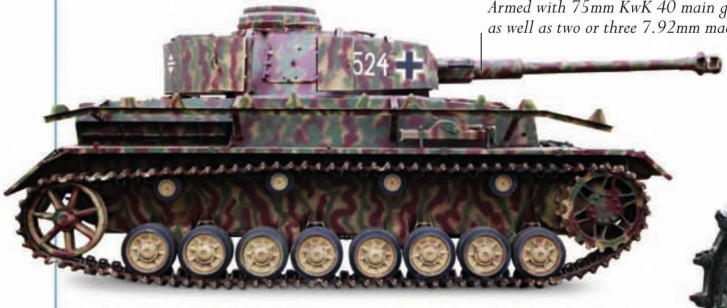
Engine SPA CV3 32kW (43hp) petrol engine

Developed from the British Carden-Lloyd tankette, this modified version of the L3-35 replaced its twin machine-guns with a flamethrower nozzle. The flame fuel was carried in a 500-litre (132-gallon) trailer towed by the vehicle.

Muzzle brake

88mm KwK 43 main gun

Mantlet



Armed with 75mm KwK 40 main gun as well as two or three 7.92mm machine-guns

▲ PANZERKAMPFWAGEN IV MEDIUM TANK

Date 1936 **Origin** Germany

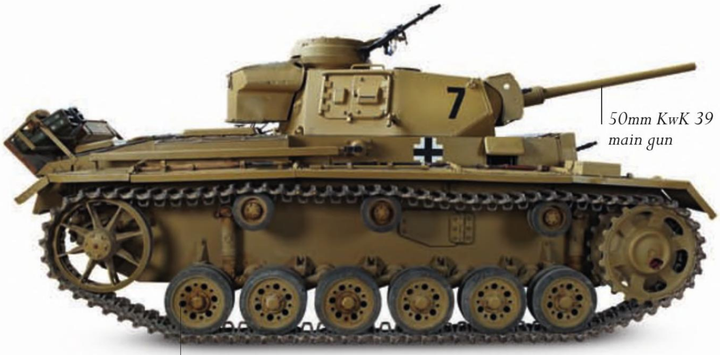
Weight 25 tonnes (27.5 tons)

Length 5.89m (19¼ft)

Top speed 38kph (24mph)

Engine Maybach HL 120TRM 12-cylinder 224kW (300hp) petrol engine

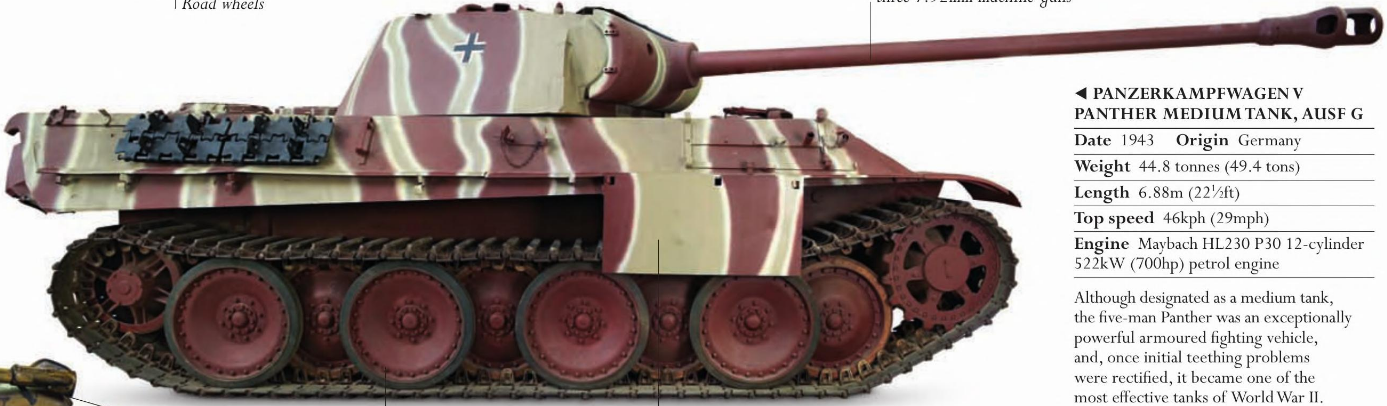
Intended to adopt the role of an infantry support vehicle, the Panzer IV developed into a potent main battle tank as a result of a series of upgrades that improved protection and firepower. With a crew of five, the Panzer IV was the only German tank to remain in service throughout the war.


50mm KwK 39 main gun
Road wheels

◀ PANZERKAMPFWAGEN III MEDIUM TANK, AUSF M

Date 1939 **Origin** Germany
Weight 23.5 tonnes (25.9 tons)
Length 6.41m (21ft)
Top speed 40kph (25mph)
Engine Maybach HL 120TRM 12-cylinder 224kW (300hp) petrol engine

The Panzer III entered service in 1939 as the German army's main battle tank, but by the end of 1941 its inferiority to the Soviet T-34 had become evident and it was adapted to act as a chassis for other armoured vehicles. This mark was manned by five crew.

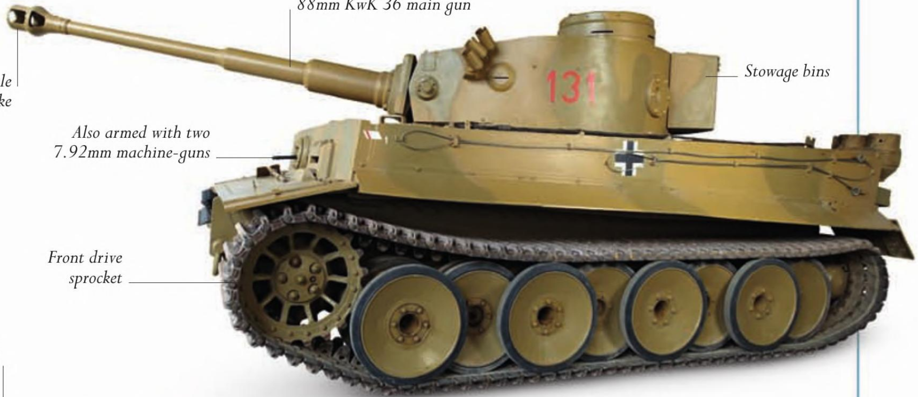

Armed with a 75mm KwK 42 main gun as well as two or three 7.92mm machine-guns
Interleaved road wheels
Bazooka plates

◀ PANZERKAMPFWAGEN V PANTHER MEDIUM TANK, AUSF G

Date 1943 **Origin** Germany
Weight 44.8 tonnes (49.4 tons)
Length 6.88m (22½ft)
Top speed 46kph (29mph)
Engine Maybach HL230 P30 12-cylinder 522kW (700hp) petrol engine

Although designated as a medium tank, the five-man Panther was an exceptionally powerful armoured fighting vehicle, and, once initial teething problems were rectified, it became one of the most effective tanks of World War II.

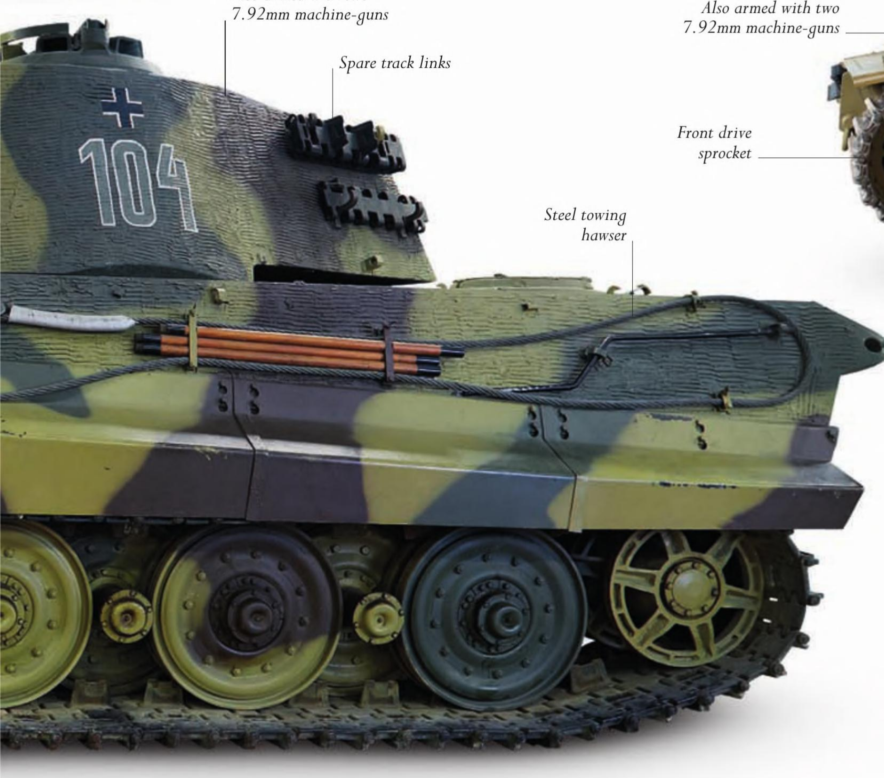
Flamethrower
Drive wheel


88mm KwK 36 main gun
Muzzle brake
Stowage bins
Also armed with two 7.92mm machine-guns
Front drive sprocket

▲ PANZERKAMPFWAGEN VI TIGER I HEAVY TANK, AUSF E

Date 1942 **Origin** Germany
Weight 56 tonnes (61.7 tons)
Length 6.20m (20¼ft)
Top speed 38kph (24mph)
Engine Maybach HL230 P45 12-cylinder 522kW (700hp) petrol engine

Adopting a design philosophy that emphasized protection and firepower, the Tiger was a fearsome weapon, but it lacked manoeuvrability. It was also costly to manufacture.


Also armed with two 7.92mm machine-guns
Spare track links
Steel towing hawser

◀ PANZERKAMPFWAGEN VI TIGER II HEAVY TANK, AUSF B

Date 1944 **Origin** Germany
Weight 69.8 tonnes (76.9 tons)
Length 7.26m (23¾ft)
Top speed 38kph (24mph)
Engine Maybach HL230 P30 12-cylinder 522kW (700hp) petrol engine

The Tiger II (or King Tiger), which was operated by five crew members, was arguably the most powerful tank fielded by any side in World War II. However, its immense weight caused a series of reliability problems, which hampered its battlefield performance.

WORLD WAR II ARMOURED VEHICLE

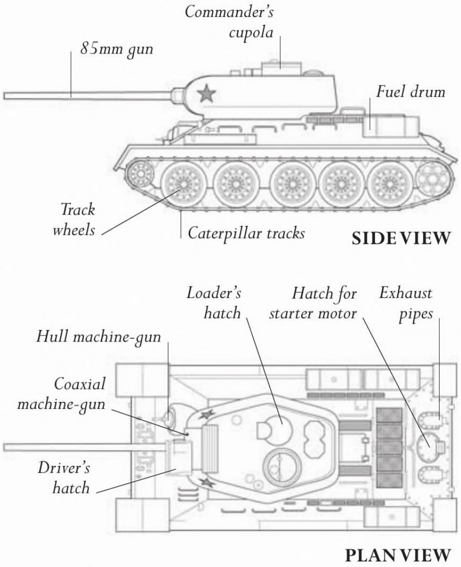
T-34 TANK

Although crudely finished, noisy, and cramped, the Soviet Union's T-34 was perhaps the most successful tank of World War II, taking on and eventually beating the formidable German panzers.

Designated the T-34/76, the tank first saw action in 1941. It mounted a 76.2mm main gun and two 7.62mm DT machine-guns, one in the turret and one in the hull. The coaxial machine-gun in the turret fired tracer rounds to guide the main gun. The T-34 had a four-man crew, with the tank commander doubling as the main gunner.

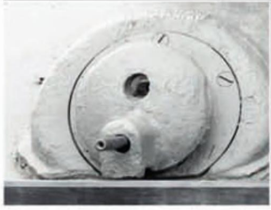
Thanks to its simple design, the T-34 was easy to mass-produce – nearly 40,000 were built before the war's end – and to repair. Relatively light in weight, it could achieve an impressive 51kph (32mph) and coped well with mud, snow, and broken ground. Its sloped armour, 100mm (4in) thick, gave good protection, while the high-velocity gun penetrated enemy armour effectively.

In 1944, with the T-34 outclassed by more advanced German tanks, the T-34/85 model entered service. Its upgraded 85mm gun gave greater firepower, and the more spacious turret, which had room for three crew, allowed the roles of commander and gunner to be separated.



▲ SOVIET T-34/85
The five-man T-34/85 had a longer main gun than its predecessor. Its flatter turret gave it a lower profile and made it a more difficult target.

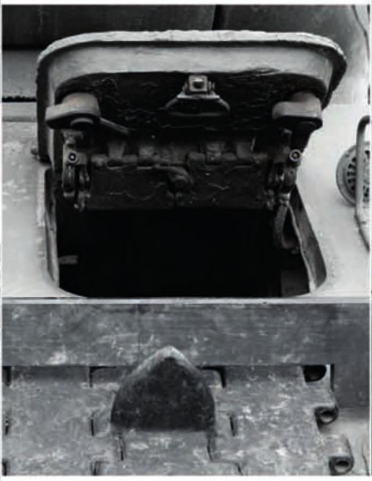
TANK EXTERIOR



▲ HULL MACHINE-GUN
The machine-gun muzzle was able to pivot on its mounting. The hole above the muzzle is a gun sight.

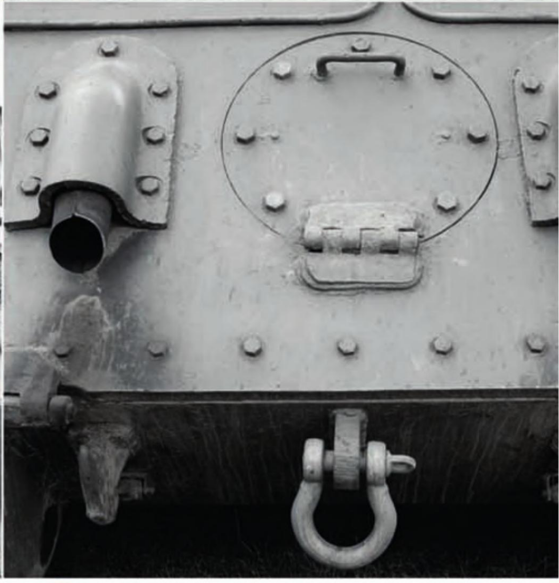
▲ TOWING ROPE EYE
A wire hawser (large rope) ran along the side of the tank. It could be used to haul damaged vehicles from the battlefield.

▼ DRIVER'S HATCH
The entrance hatch for the driver was usually left open to give him a better view of the way ahead.

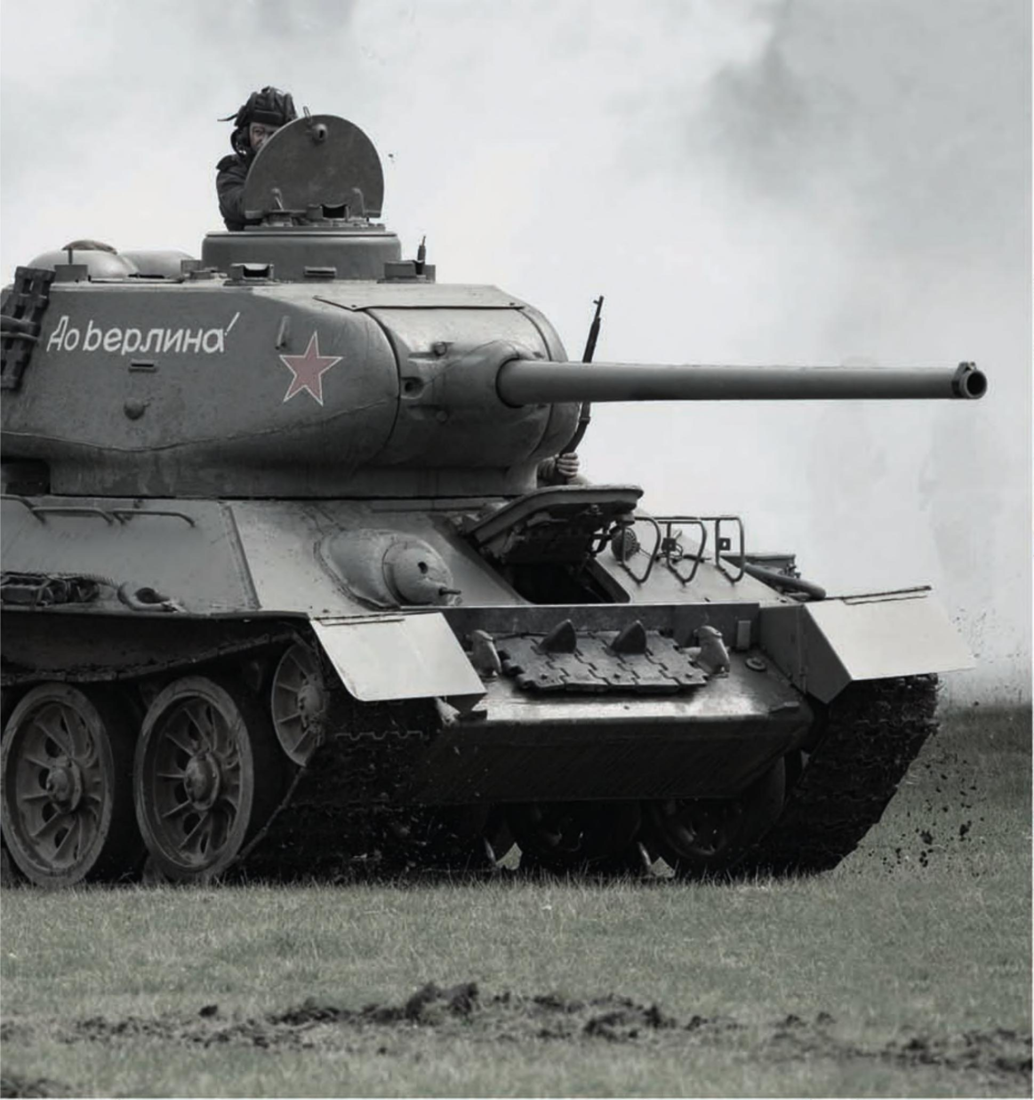


▲ FUEL DRUMS
The drums of spare diesel fuel were a fire hazard in battle, so they were usually emptied before combat.

◄ SPARE TRACK ON TURRET
Spare links for repairing the T-34's wide tracks were carried on the outside of the tank.

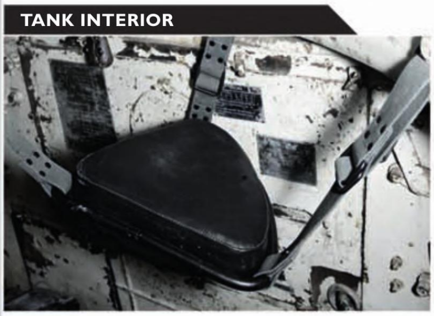


▲ EXHAUST PIPES AND STARTER MOTOR HATCH
The exhausts tended to billow clouds of smoke when the engine started up. The noisy engine could be heard from 450m (500 yards) away.

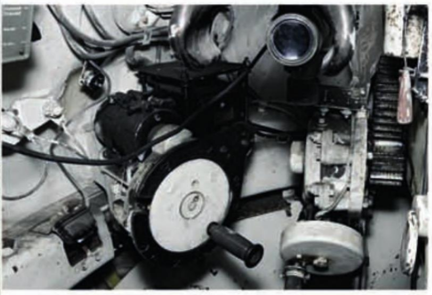


◂ **TROOP CARRIER**
Several soldiers could ride into battle on the rear platform of the T-34 and on the sides of its hull, providing instant infantry support.

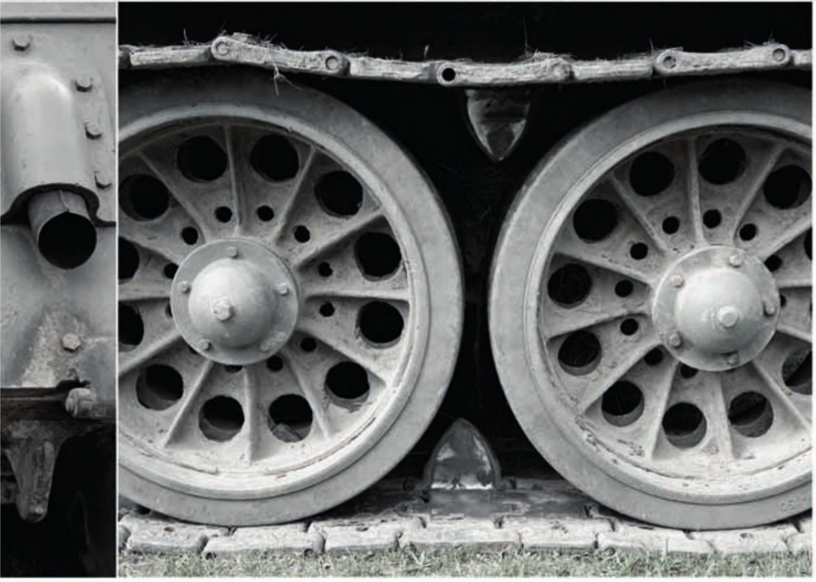
TANK INTERIOR



▲ **LOADER'S SEAT**
While dodging the main gun's recoil, the loader fetched shells from bins under the turret floor.



▲ **TURRET TRAVERSE WHEEL**
The gunner turned a wheel to traverse (rotate) the turret, and was responsible for firing the static coaxial machine-gun, in the turret to the right of the main gun.



▲ **RUNNING GEAR**
The suspension was based on an American design that had been rejected by the US Army.

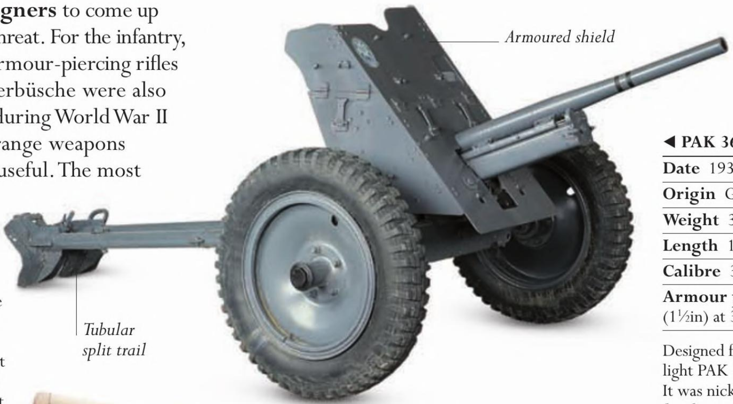
▲ **AMMUNITION DRUMS**
Tracer rounds (often fired as range finders) for the coaxial machine-gun lay ready to hand.

◂ **DRIVER'S SEAT**
Sitting beside the hull machine-gunner, the driver could see only straight ahead. He steered mainly to instructions from the commander.

ANTI-TANK WEAPONS

The advent of the tank forced arms designers to come up with weapons powerful enough to counter this threat. For the infantry, who bore the brunt of the armoured assault, armour-piercing rifles came as a solution. Weapons such as the Panzerbüsche were also successful, but improvements in tank armour during World War II rendered them obsolete. Lightweight, short-range weapons firing shaped-charge projectiles became more useful. The most effective anti-tank weapon, however, was a high-velocity artillery piece.

Rectangular frame sight


Armoured shield
Tubular split trail

◀ PAK 36 ANTI-TANK GUN

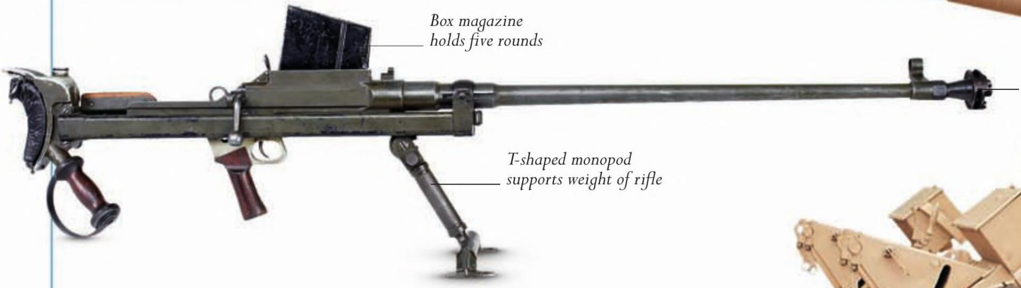
Date 1934
Origin Germany
Weight 328kg (723lb)
Length 1.66m (5½ft)
Calibre 37mm
Armour penetration 38mm (1½in) at 365m (400 yards)

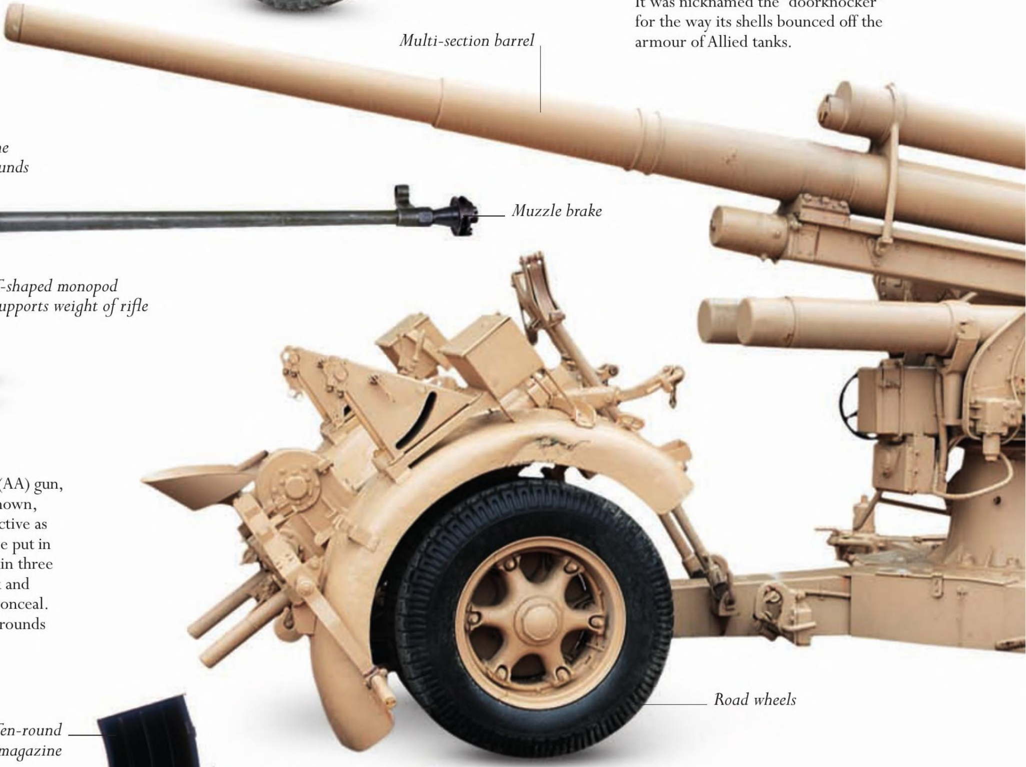
Designed for warfare in the 1930s, the light PAK 36 was obsolete by 1940. It was nicknamed the "doorknocker" for the way its shells bounced off the armour of Allied tanks.

▼ BOYS MK1 ANTI-TANK RIFLE

Date 1937
Origin UK
Weight 16.33kg (36lb)
Barrel 91cm (35¾in)
Calibre .55in
Armour penetration 21mm (¾in) at 302m (330 yards)

The Boys anti-tank rifle fired a heavy tungsten-steel round, and had a correspondingly violent recoil. However, it was only able to pierce light armour, and was replaced by the PIAT.

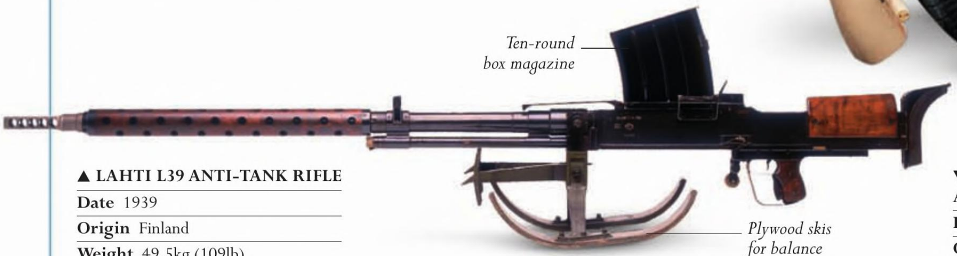

Box magazine holds five rounds
Muzzle brake
T-shaped monopod supports weight of rifle


Multi-section barrel
Road wheels

▶ FLAK 36 AA/AT GUN

Date 1936
Origin Germany
Weight 7.4 tonnes (8.1 tons)
Length 5.79m (19ft)
Calibre 88mm
Armour penetration 159mm (6¼in) at 1,000m (1,094 yards)

Designed as an anti-aircraft (AA) gun, the famed "88", as it was known, was found to be highly effective as an anti-tank gun. It could be put in position very quickly – within three minutes – although its bulk and height made it difficult to conceal. It was able to fire up to 20 rounds per minute.


Ten-round box magazine
Plywood skis for balance

▲ LAHTI L39 ANTI-TANK RIFLE

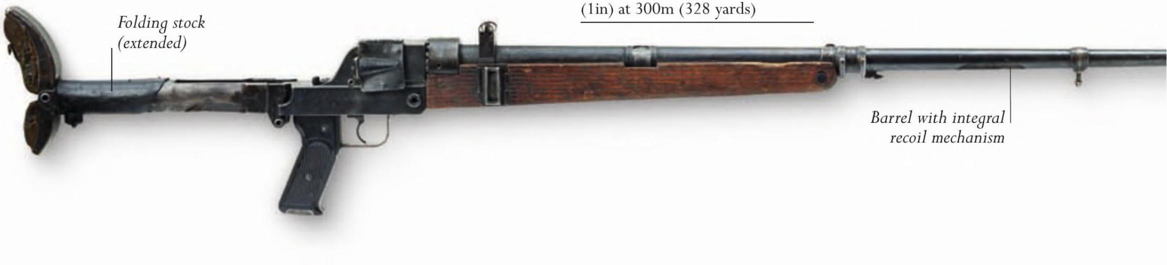
Date 1939
Origin Finland
Weight 49.5kg (109lb)
Barrel 1.3m (4¼ft)
Calibre 20 × 138Bmm
Armour penetration 30mm (1¼in) at 100m (109 yards)

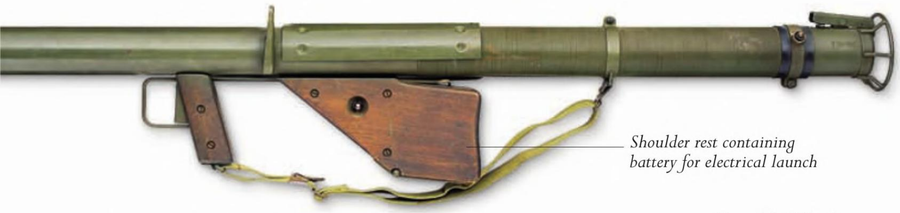
The L39's enormous size and weight gave it the nickname "Elephant Gun". It was used to good effect during the Winter War of 1939–40.

▼ PANZERBÜSCHE 39 ANTI-TANK RIFLE

Date 1940
Origin Germany
Weight 12.6kg (27¾lb)
Barrel 1.08m (3½ft)
Calibre 7.92 × 94mm
Armour penetration 25mm (1in) at 300m (328 yards)

The Panzerbüsche 39 relied on its very high muzzle velocity and tungsten-cored bullet to penetrate enemy armour. It was, however, expensive to manufacture, and was only produced in small numbers.


Folding stock (extended)
Barrel with integral recoil mechanism


Shoulder rest containing battery for electrical launch

▲ M1A1 "BAZOOKA"

Date 1942

Origin US

Weight 6kg (13¼lb)

Length 1.37m (4½ft)

Calibre 60mm

Armour penetration 120mm (4¾in) at 138m (150 yards)

The Bazooka was essentially a tube that launched a solid fuel rocket with a shaped-charge warhead. It was operated by two men – one who fired and one who loaded.

▼ PIAT

Date 1942

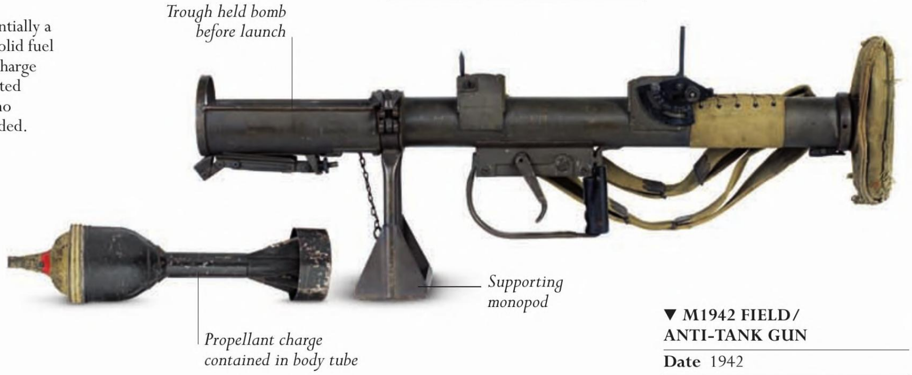
Origin UK

Weight 14.5kg (32lb)

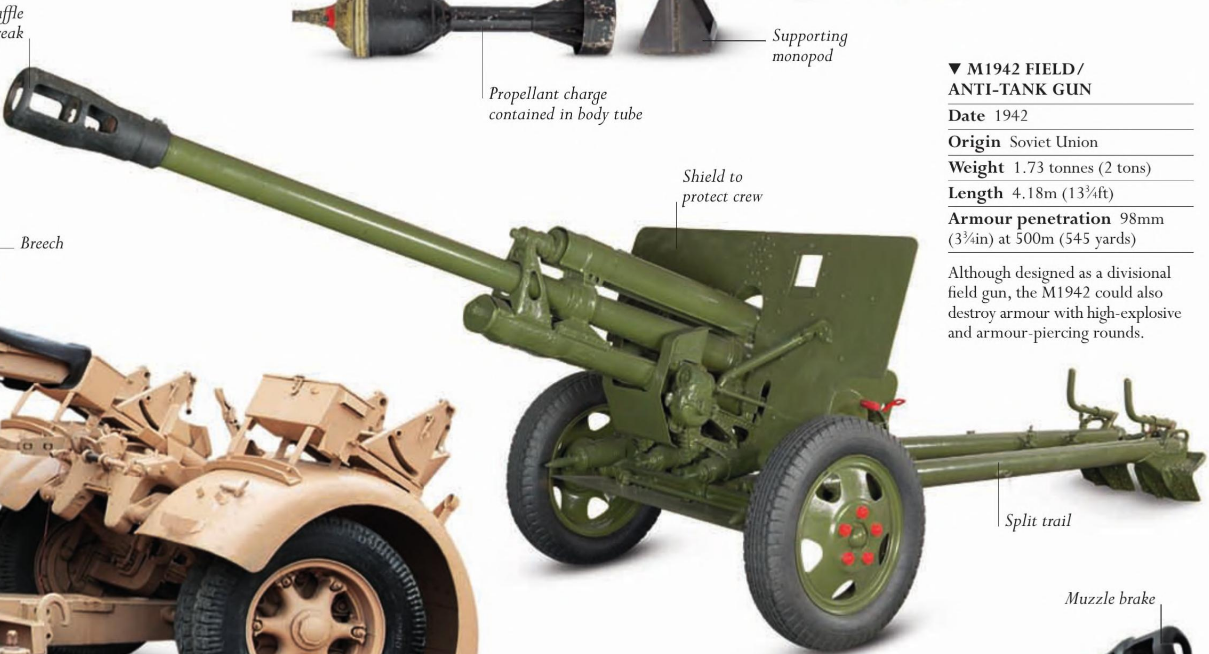
Length 99cm (39in)

Armour penetration 75mm (3in) at 110m (120 yards)

The PIAT (Projector, Infantry, Anti-Tank), like the Sten, was a wartime expedient design that put function before form. It was actually a spigot mortar that fired a bomb with a shaped-charge warhead.


Trough held bomb before launch
Supporting monopod
Propellant charge contained in body tube

Breech
Stabilizing leg (unfolded)


Double baffle muzzle break
Shield to protect crew
Split trail

▼ M1942 FIELD/ ANTI-TANK GUN

Date 1942

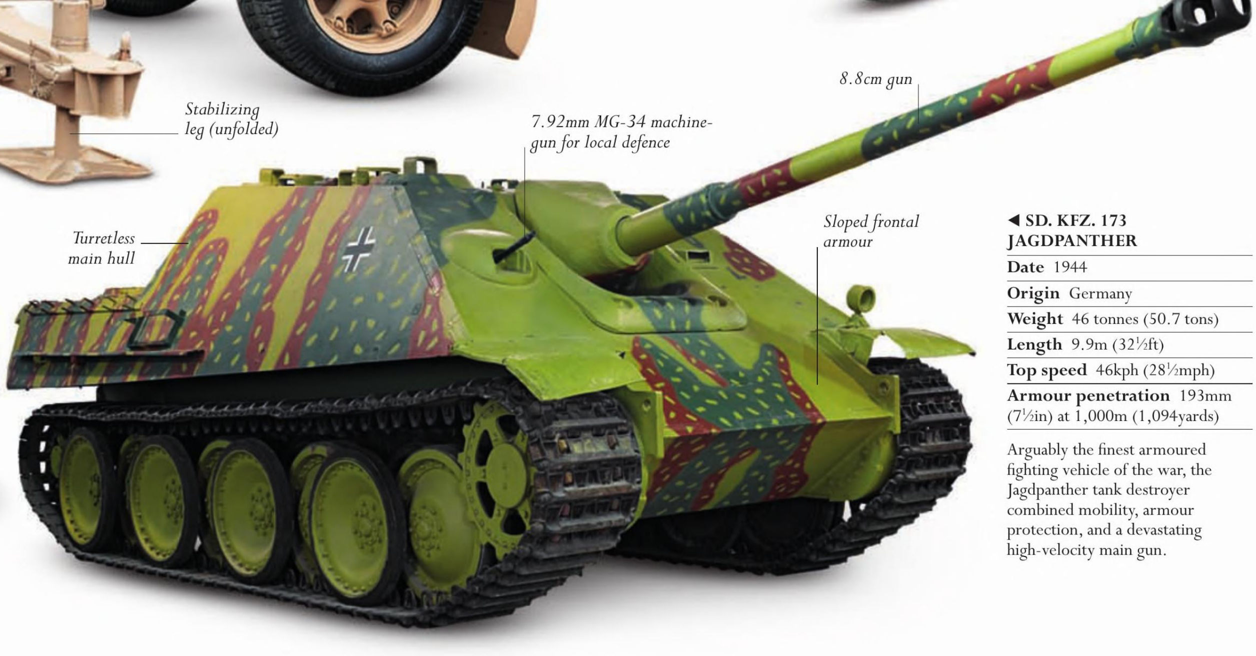
Origin Soviet Union

Weight 1.73 tonnes (2 tons)

Length 4.18m (13¾ft)

Armour penetration 98mm (3¾in) at 500m (545 yards)

Although designed as a divisional field gun, the M1942 could also destroy armour with high-explosive and armour-piercing rounds.


Muzzle brake
8.8cm gun
7.92mm MG-34 machine-gun for local defence
Sloped frontal armour
Turretless main hull

Muzzle brake

◀ SD. KFZ. 173 JAGDPANTHER

Date 1944

Origin Germany

Weight 46 tonnes (50.7 tons)

Length 9.9m (32½ft)

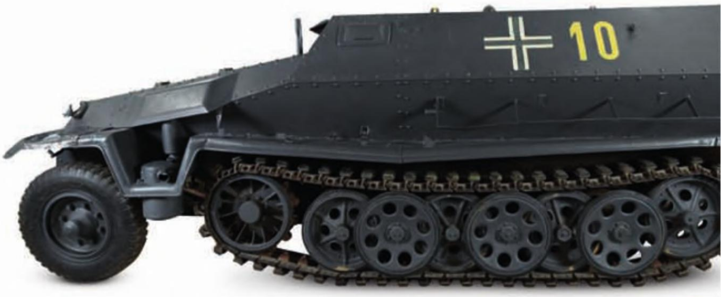
Top speed 46kph (28½mph)

Armour penetration 193mm (7½in) at 1,000m (1,094yards)

Arguably the finest armoured fighting vehicle of the war, the Jagdpanther tank destroyer combined mobility, armour protection, and a devastating high-velocity main gun.

TRUCKS, HALF-TRACKS, AND LIGHT VEHICLES

While tanks and other armoured fighting vehicles have been regarded as the most effective vehicles of World War II, it was the trucks, cars, half-tracks, and other light vehicles that provided the vital logistical backup to the vast armies of the Allies and the Axis powers. For the first time in history, troops in auxiliary services began to outnumber front-line troops. Such support was vital. Not only were there a vast range of vehicles, but a specific model could also come in a bewildering range of variants, each designed to suit a particular role in differing conditions.



▲ **SDKFZ 251-8 AUSF C HALF-TRACK**

Date 1940 **Origin** Germany

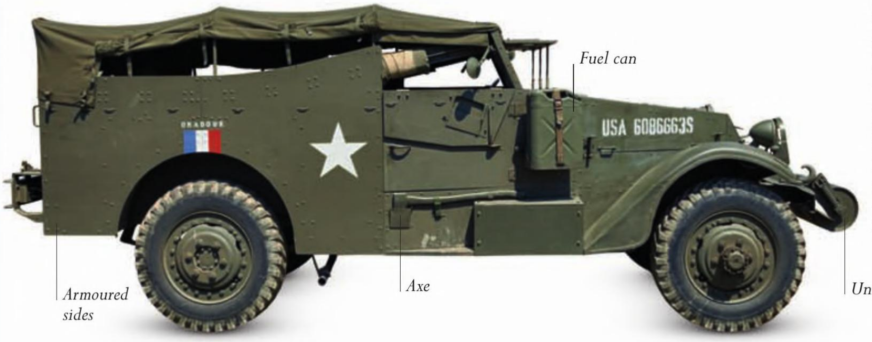
Weight 7.8 tonnes (8.6 tons)

Length 5.8m (19ft)

Top speed 52.5kph (33mph)

Engine Maybach HL 42 6-cylinder 74.6kW (100hp) petrol engine

Although originally intended as an APC (Armoured Personnel Carrier), the SDKFZ 251 half-track proved so useful that at least 22 separate variants were developed, including this 251-8 battlefield ambulance. Other variants included anti-tank, rocket launcher, and anti-aircraft versions.



Fuel can

Armoured sides

Axe

Unditching roller

▲ **M3A1 SCOUT CAR**

Date 1940 **Origin** US

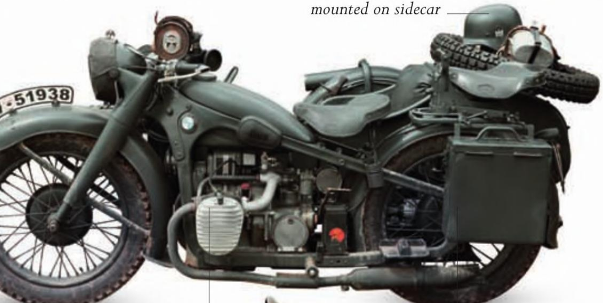
Weight 4.03 tonnes (4.4 tons)

Length 5.6m (18¼ft)

Top speed 89kph (55mph)

Engine Hercules JXD 6-cylinder 82kW (110hp) petrol engine

Developed as a light armoured car to support American mechanized formations, the M3A1 suffered from poor off-road mobility, although its best design features were incorporated into the half-tracks that succeeded it.



Helmet and canteen on spare wheel, mounted on sidecar

Cylinder head

Side pannier

▶ **R75 MOTORCYCLE COMBINATION**

Date 1941 **Origin** Germany

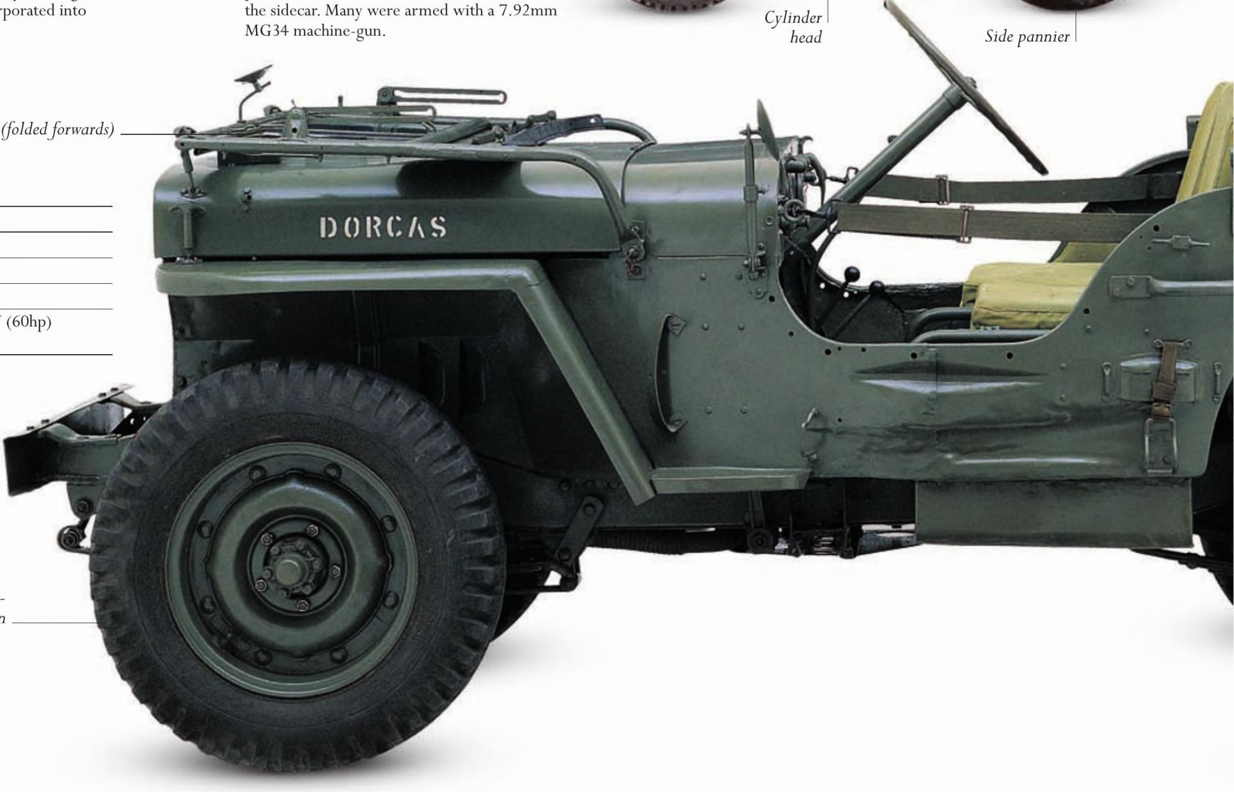
Weight 400kg (882lb)

Length 2.4m (7¾ft)

Top speed 95kph (59mph)

Engine Four-stroke 2-cylinder flat-twin 19kW (25hp) petrol engine

Manufactured by BMW, the R75 was powered by a 750cc engine and utilized a drivetrain that powered the rear wheels of both the bike and the sidecar. Many were armed with a 7.92mm MG34 machine-gun.



Windscreen (folded forwards)

Wheel with four-wheel-drive transmission

▶ **WILLYS JEEP**

Date 1941 **Origin** US

Weight 1.04 tonnes (1.14 tons)

Length 3.33m (11ft)

Top speed 89kph (55mph)

Engine Willys 4-cylinder 45kW (60hp) petrol engine

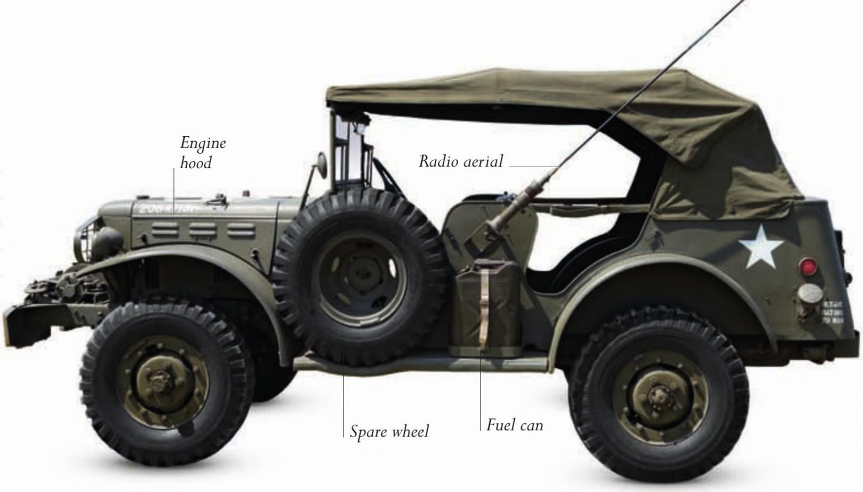
Technically known as a truck, but more commonly called a jeep, this iconic World War II vehicle was rugged, reliable, and eminently versatile. It had space for four crew.

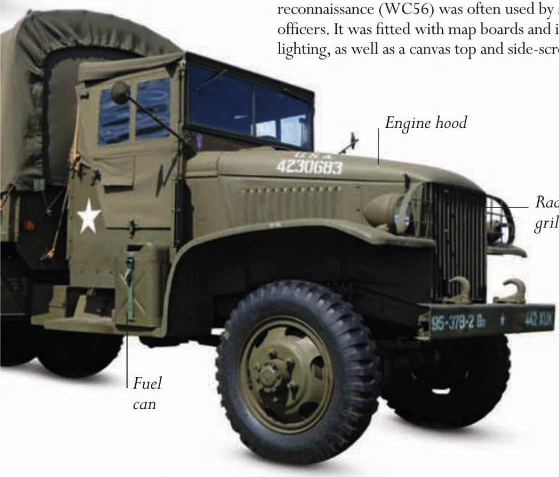
Angled armour plate

▶ DODGE T214-WC56 COMMAND RECONNAISSANCE LIGHT TRUCK

Date 1942 **Origin** US
Weight 2.45 tonnes (2.7 tons)
Length 4.24m (14ft)
Top speed 87kph (54mph)
Engine Dodge T214 6-cylinder 69kW (92hp) petrol engine

One of a series of light trucks, the command reconnaissance (WC56) was often used by senior officers. It was fitted with map boards and internal lighting, as well as a canvas top and side-screens.

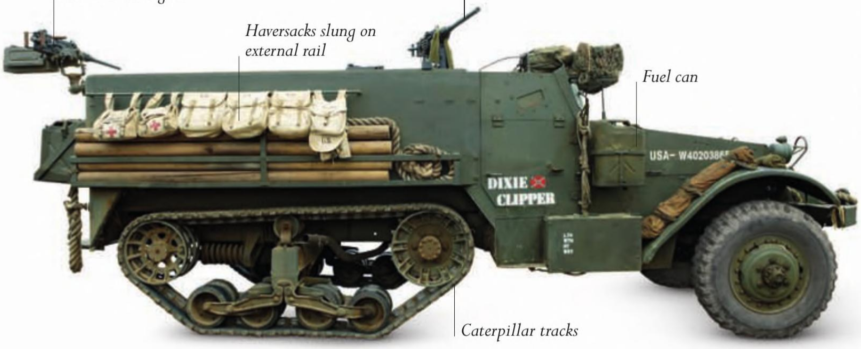

Engine hood
Radio aerial
Spare wheel
Fuel can


Engine hood
Radiator grill
Fuel can

▲ GMC 2½-TON 6X6 TRUCK

Date 1939 **Origin** US
Weight 4.58 tonnes (5.05 tons)
Length 6.5m (21¼ft)
Top speed 72kph (45mph)
Engine 6-cylinder 67.3kW (90hp) petrol engine

Nicknamed the "Jimmy", the GMC-produced truck was one of the workhorses of American logistics in Europe from 1944 to 1945. Reliable, with a good cargo load, the six-wheel-drive vehicle could cope with all but the roughest conditions.


Rear machine-gun
Haversacks slung on external rail
Forward machine-gun
Fuel can
Caterpillar tracks

▲ M5 HALF-TRACK

Date 1942 **Origin** US
Weight 9.3 tonnes (10.2 tons)
Length 6.33m (20¾ft)
Top speed 68kph (42mph)
Engine International Harvester RED-450-B 6-cylinder 105kW (141hp) petrol engine

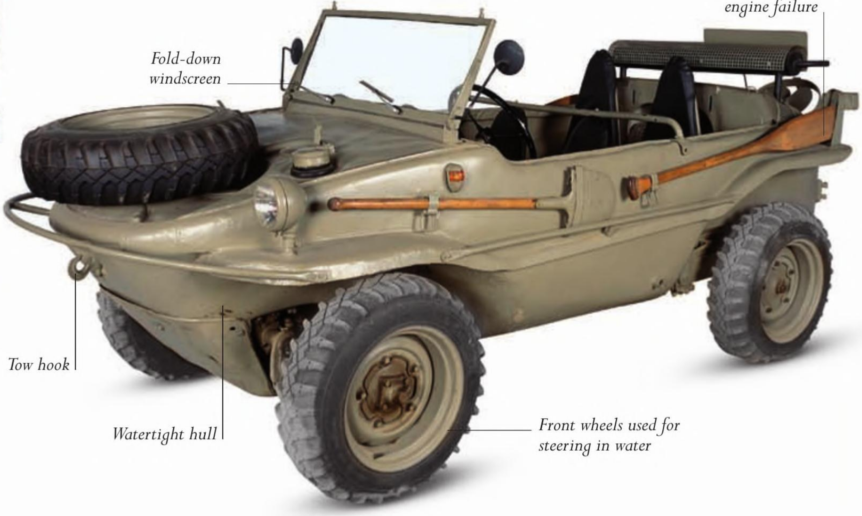
Designed to provide mobility and protection for infantry advancing into battle, this M5 was broadly similar to its more famous M3 cousin. More than 40,000 half-tracks of various specifications were used by the US during World War II.

▼ SCHWIMMWAGEN

Date 1942 **Origin** Germany
Weight 910kg (2,006lb)
Length 3.83m (12½ft)
Top speed 80kph (50mph); 10kph (6mph) on water
Engine 4-cylinder air-cooled 18.4kW (25hp) petrol engine

Based on the Volkswagen, the *Schwimmwagen* (swimming car) was a fully amphibious four-wheel-drive vehicle, which could tackle snow, mud, and water obstacles encountered on campaign.

Spare wheel
Fuel can
Leaf suspension


Paddle in case of engine failure
Fold-down windscreen
Tow hook
Watertight hull
Front wheels used for steering in water

UNIFORMS AND EQUIPMENT

During World War II, military uniforms went through a transitional phase as old gave way to new. Traditional uniforms – such as those worn by the Japanese infantryman – distinguished the soldier from both the enemy and civilians, and provided him with a sense of solidarity with his fellow troops. The new functional uniforms, however, typically worn by specialists such as fliers and armoured troops, were designed with practical considerations in mind. This approach to uniform would become increasingly common in the post-war era.

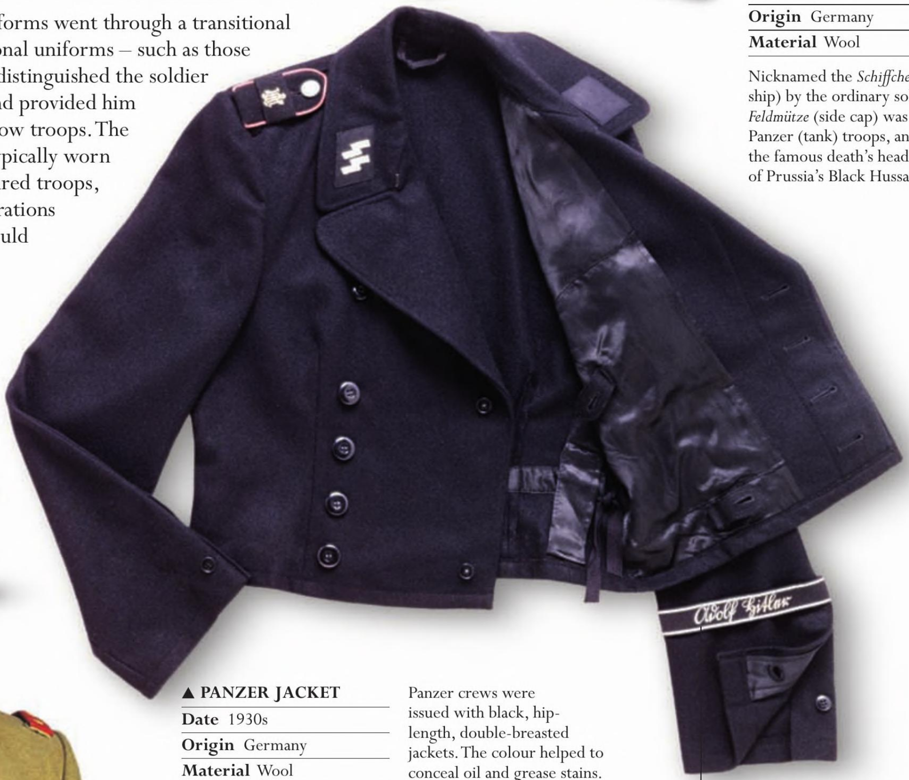
◀ FELDMÜTZE

Date 1934

Origin Germany

Material Wool

Nicknamed the *Schiffchen* (little ship) by the ordinary soldier, the *Feldmütze* (side cap) was issued to Panzer (tank) troops, and included the famous death's head insignia of Prussia's Black Hussars.



Cuff title of SS-Leibstandarte Adolf Hitler division, Hitler's personal bodyguard

▲ PANZER JACKET

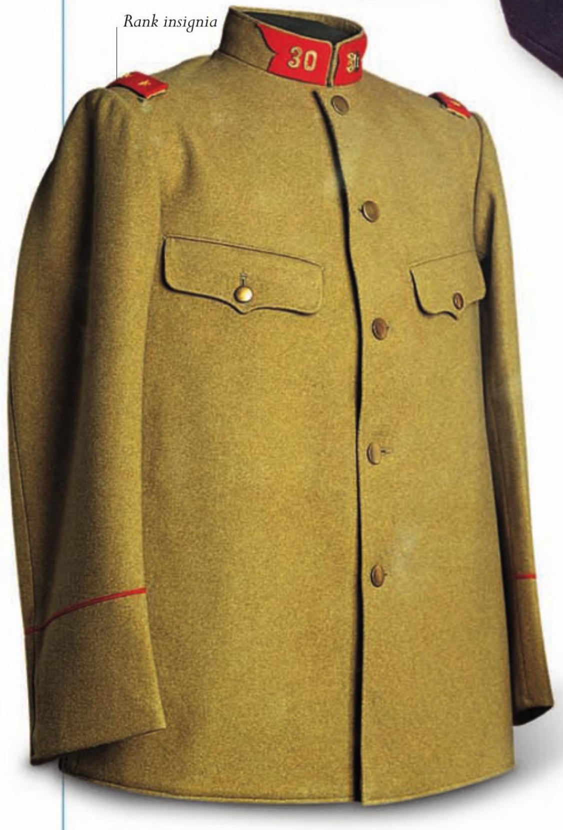
Date 1930s

Origin Germany

Material Wool

Panzer crews were issued with black, hip-length, double-breasted jackets. The colour helped to conceal oil and grease stains.

Leather peak



Rank insignia

▲ IMPERIAL JAPANESE ARMY UNIFORM

Date 1930

Origin Japan

Material Cotton (wool in winter)

This infantryman's uniform was worn during the early stages of World War II. It consisted of a peaked cap and the single-breasted M90 tunic, which had a stand-and-fall collar.

Helmet pressed from single steel sheet

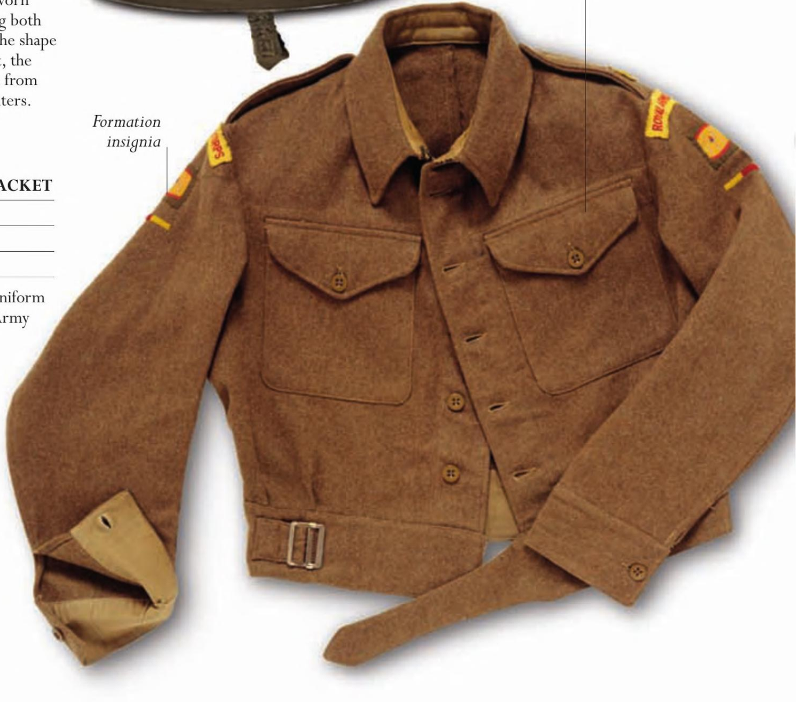
▶ BRODIE HELMET

Date 1939

Origin UK

Material Steel

Designed by the British inventor John Brodie, this was the standard steel helmet worn by British troops during both world wars. Based on the shape of a medieval kettle hat, the helmet gave protection from shrapnel and shell splinters.



Formation insignia

P40 "austerity version" without pleated pockets and front fly

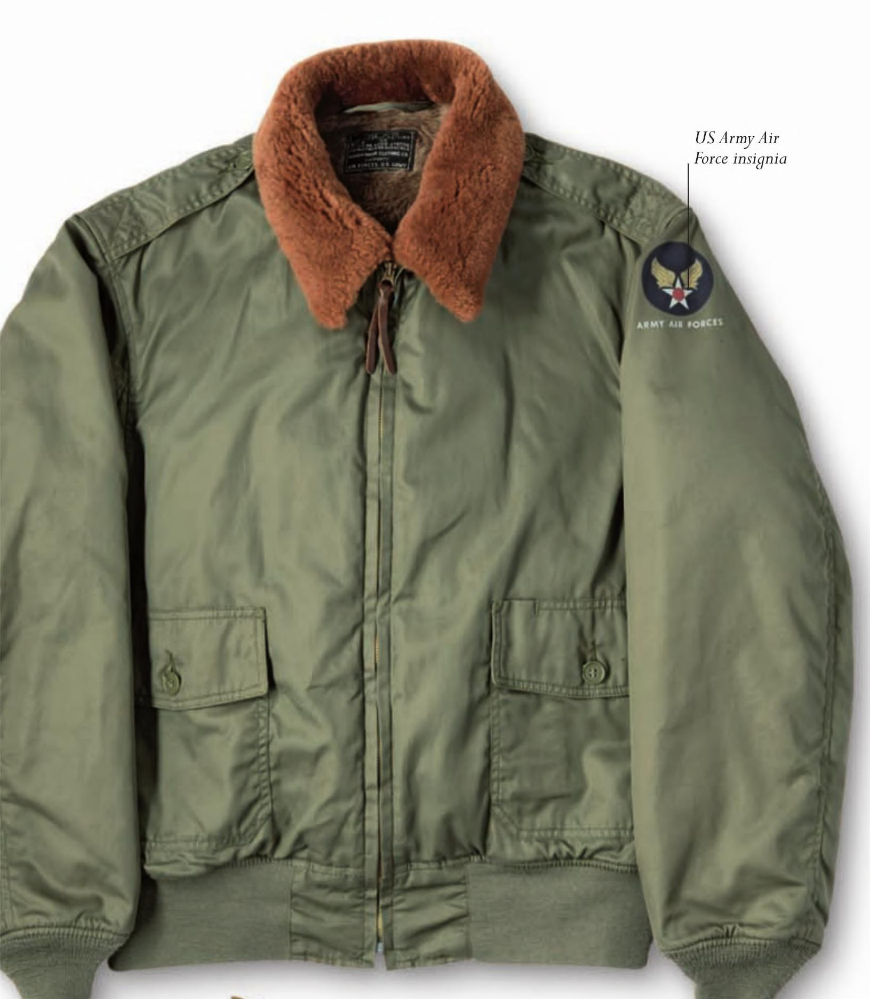
▶ BATTLEDRESS JACKET

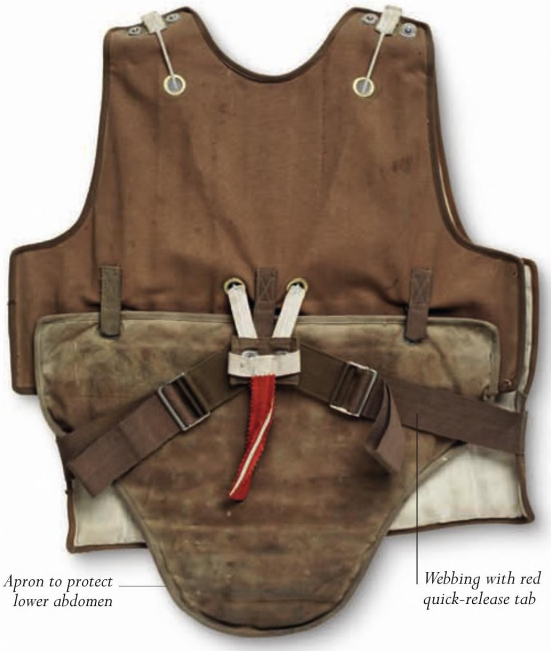
Date 1942

Origin UK

Material Wool

Battledress was a new uniform adopted by the British Army from 1939 onwards. It included trousers and a short jacket (or blouse). This simpler P40 battledress jacket utilized less fabric and was introduced in 1942.


US Army Air Force insignia
ARMY AIR FORCES

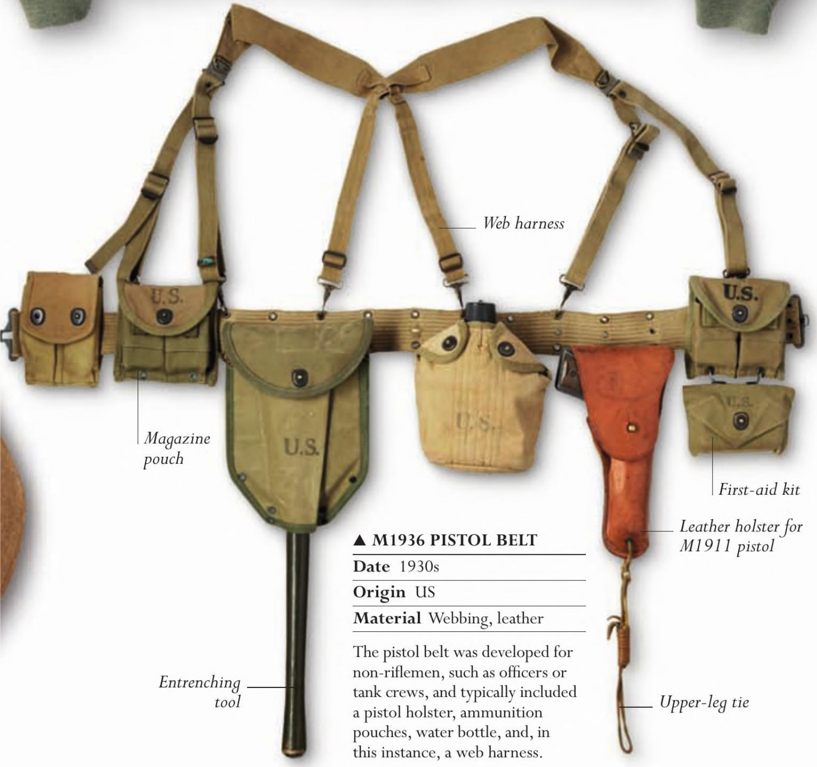

Apron to protect lower abdomen
Webbing with red quick-release tab

▲ FLAK JACKET
Date 1942
Origin US
Material Nylon, steel

Designed to protect US bomber crews from low-velocity fragments, these early examples of flak jackets consisted of steel plates sewn into a multi-layered nylon jerkin.

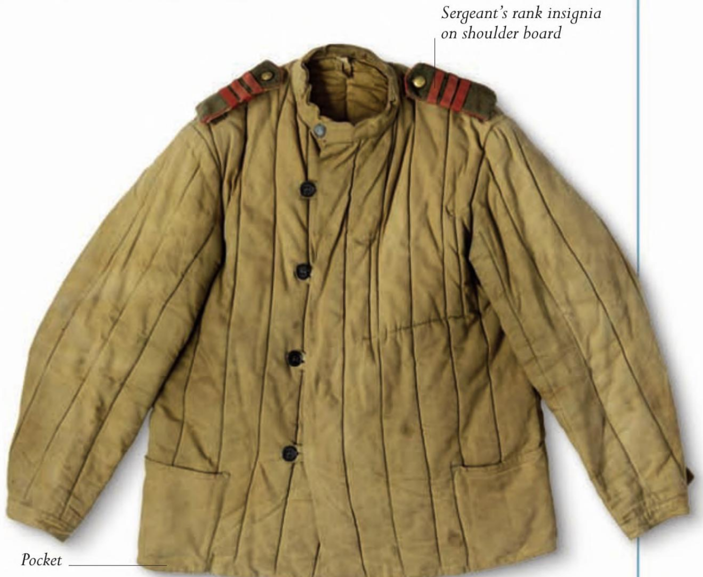
◀ B10 FLYING JACKET
Date 1943
Origin US
Material Cotton (with alpaca lining)

Issued to US air crews, the B10 featured a fur collar and zip opening. It also had knitted wrists and waistband to help its wearer retain body warmth.


Web harness
U.S.
Magazine pouch
First-aid kit
Leather holster for M1911 pistol
Entrenching tool
Upper-leg tie

▲ M1936 PISTOL BELT
Date 1930s
Origin US
Material Webbing, leather

The pistol belt was developed for non-riflemen, such as officers or tank crews, and typically included a pistol holster, ammunition pouches, water bottle, and, in this instance, a web harness.

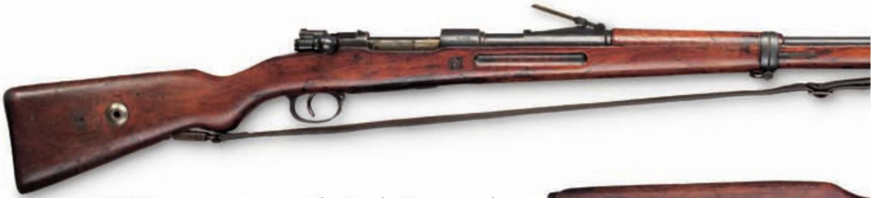

Sergeant's rank insignia on shoulder board
Pocket

▲ TELOGREIKA
Date 1930s
Origin Soviet Union
Material Cotton, cotton wool

The *telogreika* (body warmer) was a quilted jacket issued to Soviet troops during the winter months. The fabric of the jacket was stuffed with cotton wool, which helped keep out the worst of the cold.

SELF-LOADING RIFLES

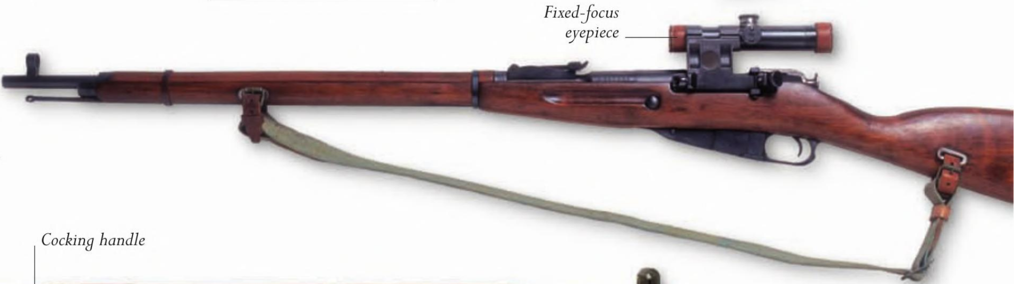
The old bolt-action rifles developed during the final years of the 19th century were still in service at the outbreak of World War II, and despite their age remained highly effective. But the war proved to be a transitional stage for the rifle. The first major breakthrough took place with the introduction of the self-loading rifle, which allowed repeated shots to be fired by simply pulling the trigger. The key development, however, came with the German Sturmgewehr 44, the first assault rifle and forerunner of the AK47, its revolutionary medium-powered 7.92 × 33mm cartridge allowing soldiers to deliver effective automatic fire for the first time.



▲ **MAUSER INFANTERIEGEWEHR 98**

Date 1898
Origin Germany
Weight 4.15kg (9lb)
Barrel 74cm (29in)
Calibre 7.92mm

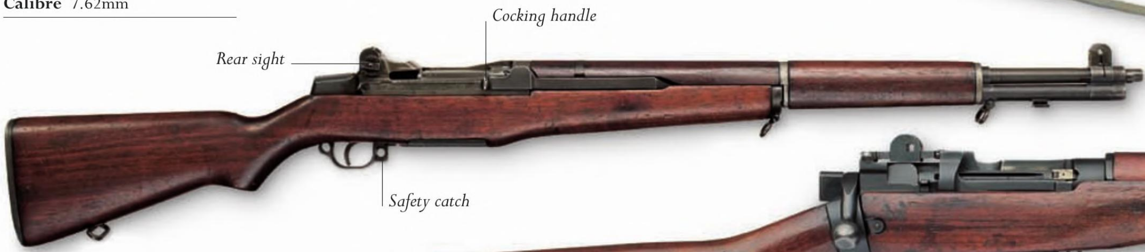
The Gewehr 98 was issued to the German army during both World Wars. Although somewhat cumbersome when used in confined spaces, the rifle was rugged, reliable, and accurate.



▶ **MOSIN-NAGANT M1891/30PU**

Date 1930
Origin Soviet Union
Weight 4kg (8¾lb)
Barrel 73cm (29in)
Calibre 7.62mm

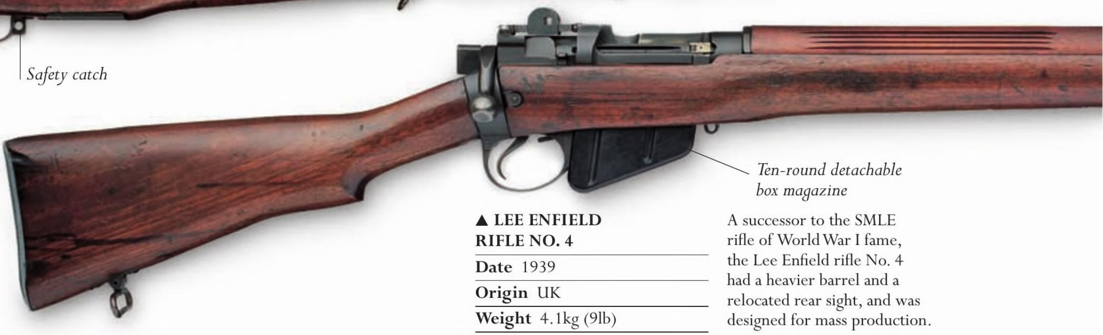
The M1891/30 was the standard rifle of the Red Army during World War II. Selected models of the rifle were fitted with a 3.5-power PU telescopic sight, to be used by snipers.



▲ **M1 GARAND RIFLE**

Date 1932
Origin US
Weight 4.31kg (9½lb)
Barrel 61cm (24in)
Calibre .30-06

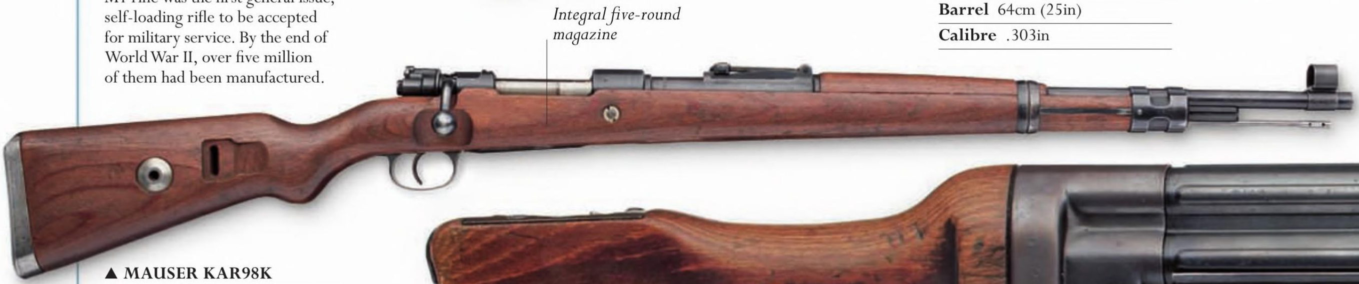
Designed by John Garand, the M1 rifle was the first general issue, self-loading rifle to be accepted for military service. By the end of World War II, over five million of them had been manufactured.



▲ **LEE ENFIELD RIFLE NO. 4**

Date 1939
Origin UK
Weight 4.1kg (9lb)
Barrel 64cm (25in)
Calibre .303in

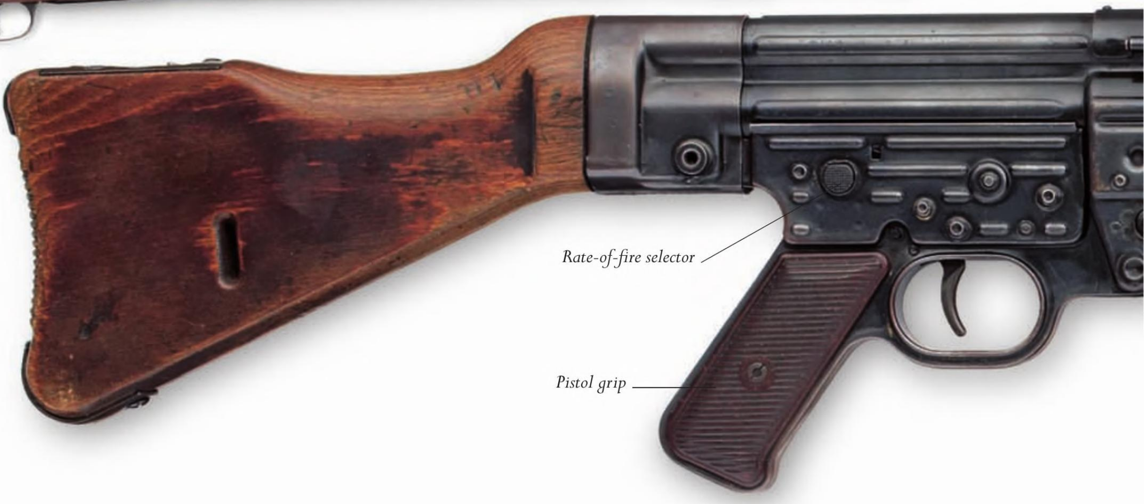
A successor to the SMLE rifle of World War I fame, the Lee Enfield rifle No. 4 had a heavier barrel and a relocated rear sight, and was designed for mass production.



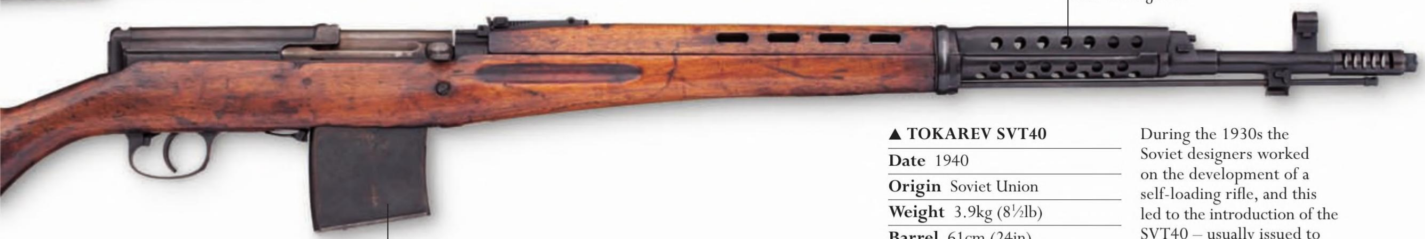
▲ **MAUSER KAR98K**

Date 1935
Origin Germany
Weight 3.9kg (8½lb)
Barrel 60cm (23½in)
Calibre 7.92mm × 57

The "Karabiner" 98K was a modified version of the Gewehr 98, and became the standard German rifle of World War II. More than 14 million were manufactured between 1935 and 1945. During that time, the design was further simplified to speed up production.



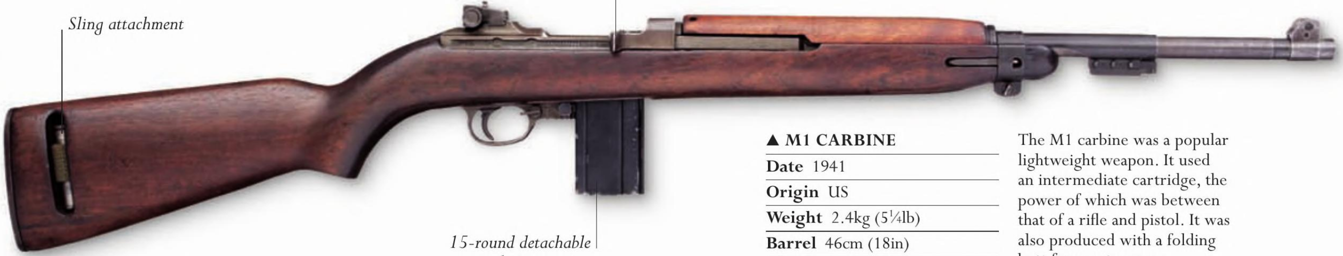
Cleaning rod


Perforated sheet-steel hand guard
Ten-round detachable box magazine

▲ TOKAREV SVT40

Date	1940
Origin	Soviet Union
Weight	3.9kg (8½lb)
Barrel	61cm (24in)
Calibre	7.62mm × 54R

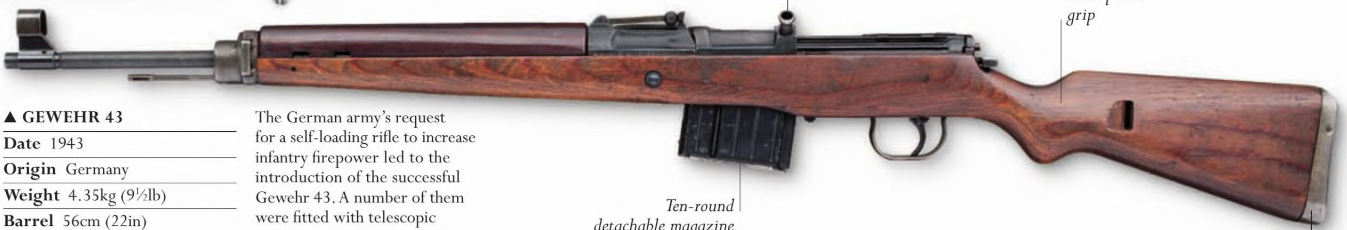
During the 1930s the Soviet designers worked on the development of a self-loading rifle, and this led to the introduction of the SVT40 – usually issued to NCOs or trained marksmen.


Cocking handle
Sling attachment
15-round detachable box magazine

▲ M1 CARBINE

Date	1941
Origin	US
Weight	2.4kg (5¼lb)
Barrel	46cm (18in)
Calibre	.30in Carbine

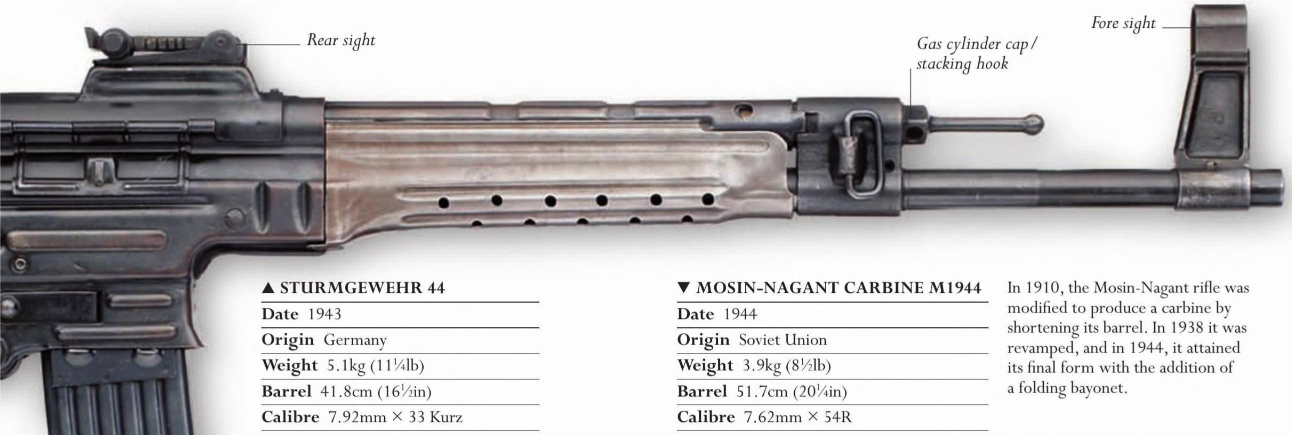
The M1 carbine was a popular lightweight weapon. It used an intermediate cartridge, the power of which was between that of a rifle and pistol. It was also produced with a folding butt for paratroopers.


Cocking handle
Semi-pistol grip
Ten-round detachable magazine
Steel butt plate

▲ GEWEHR 43

Date	1943
Origin	Germany
Weight	4.35kg (9½lb)
Barrel	56cm (22in)
Calibre	7.92mm × 57

The German army's request for a self-loading rifle to increase infantry firepower led to the introduction of the successful Gewehr 43. A number of them were fitted with telescopic sights and used as sniper rifles.


Rear sight
Gas cylinder cap / stacking hook
Fore sight

▲ STURMGEWEHR 44

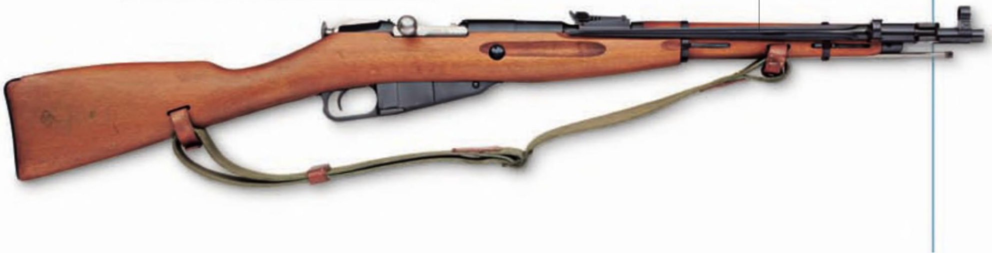
Date	1943
Origin	Germany
Weight	5.1kg (11¼lb)
Barrel	41.8cm (16½in)
Calibre	7.92mm × 33 Kurz

One of the most influential firearms of the 20th century, the StG 44 was manufactured using pressed steel that was easier to produce. Its medium-powered cartridge enabled properly controlled automatic fire.

▼ MOSIN-NAGANT CARBINE M1944

Date	1944
Origin	Soviet Union
Weight	3.9kg (8½lb)
Barrel	51.7cm (20¼in)
Calibre	7.62mm × 54R

In 1910, the Mosin-Nagant rifle was modified to produce a carbine by shortening its barrel. In 1938 it was revamped, and in 1944, it attained its final form with the addition of a folding bayonet.


Folding cruciform bayonet

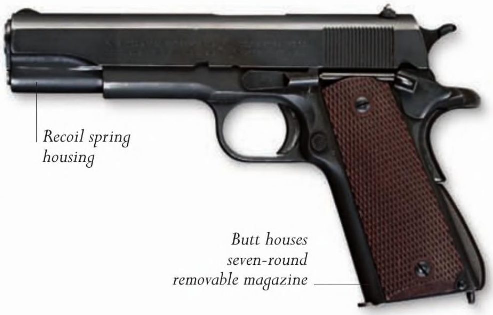
PERSONAL WEAPONS

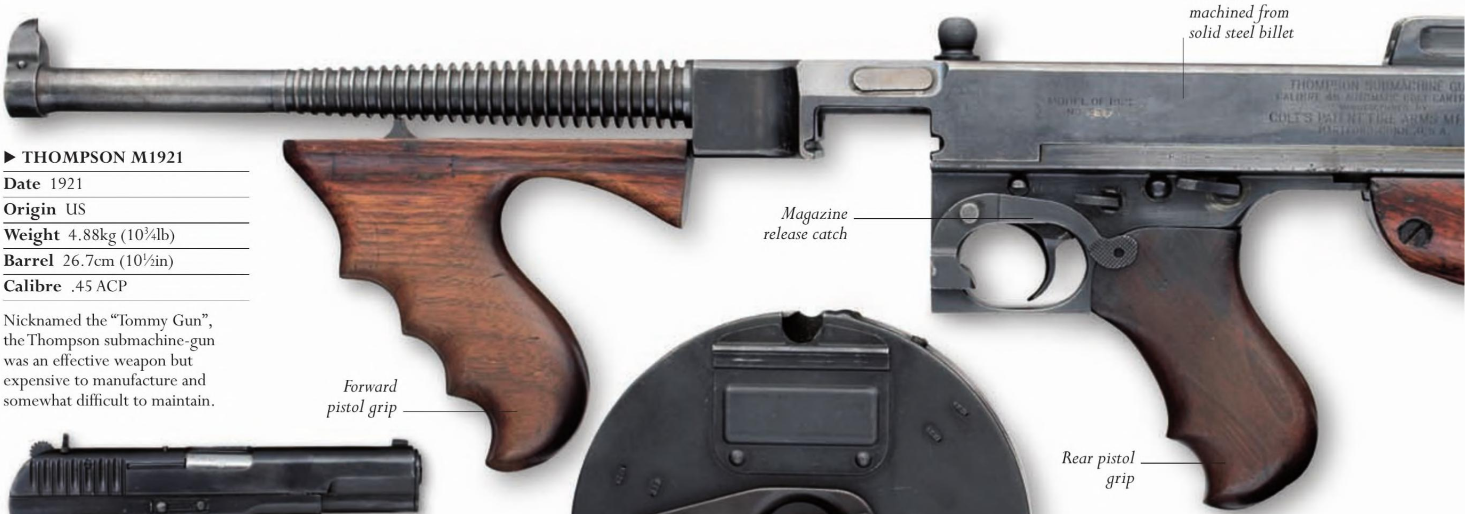
While the rifle was the prime weapon of the infantryman, other troops, such as officers, NCOs, tank crews, and airmen, required something more manoeuvrable for their personal protection. The solution to their requirement was provided by submachine-guns, pistols, and revolvers – all of which used the light but low-powered pistol round. In practice, revolvers and pistols were rarely used in combat, but the submachine-gun, which was light and had a high rate of automatic fire, proved to be a key weapon of World War II. It was particularly useful in close-combat conditions, such as house-clearing and jungle fighting.

▶ COLT M1911A1

Date	1924
Origin	US
Weight	1.1kg (2½lb)
Barrel	12.7cm (5in)
Calibre	.45in ACP

Adopted in response to demands for a handgun with guaranteed stopping power, the Browning-designed M1911A1 replaced the M1911 of World War I. It was used by the US armed forces during World War II and after.


Recoil spring housing
Butt houses seven-round removable magazine


Receiver machined from solid steel billet
Magazine release catch
Forward pistol grip
Rear pistol grip

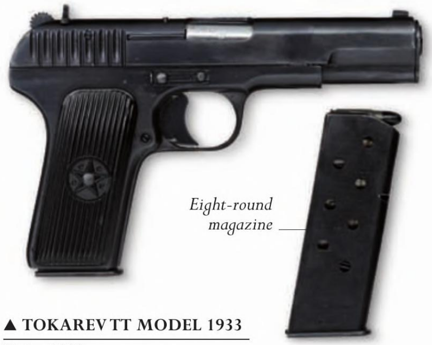
▶ THOMPSON M1921

Date	1921
Origin	US
Weight	4.88kg (10¾lb)
Barrel	26.7cm (10½in)
Calibre	.45 ACP

Nicknamed the "Tommy Gun", the Thompson submachine-gun was an effective weapon but expensive to manufacture and somewhat difficult to maintain.

Winder for clockwork mechanism

50-ROUND
DRUM MAGAZINE


Eight-round magazine

▲ TOKAREV TT MODEL 1933

Date	1933
Origin	Soviet Union
Weight	830g (29½oz)
Barrel	11.6cm (4½in)
Calibre	7.62mm

The Tokarev TT33 was the first self-loading pistol to be issued to the Red Army. It lacked a safety catch, but could be put on half-cock.

▶ BROWNING GP35

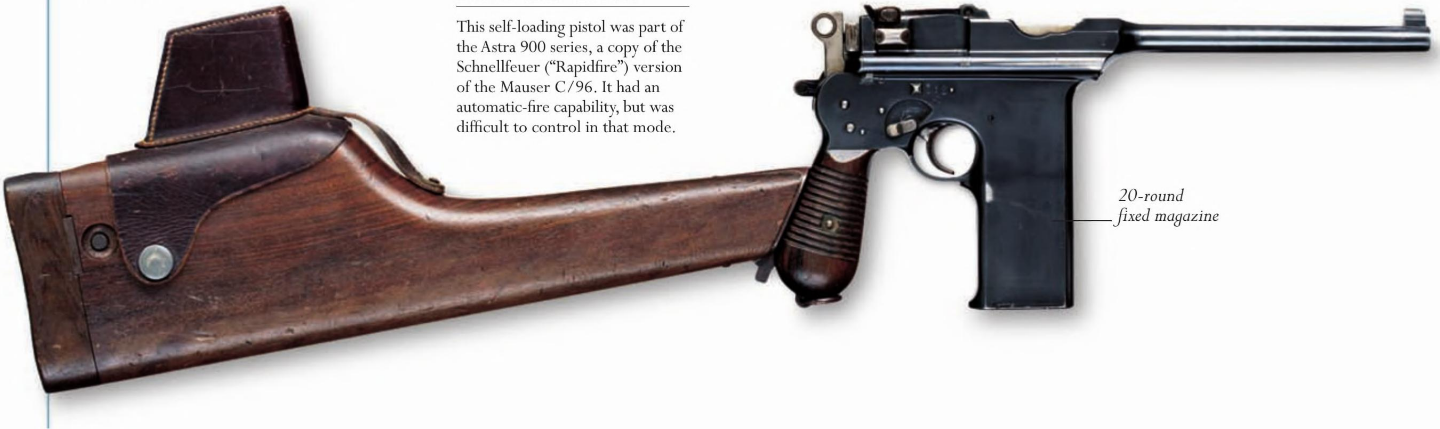
Date	1935
Origin	Belgium
Weight	990g (35oz)
Barrel	11.8cm (4¾in)
Calibre	9mm Parabellum

A Browning-designed pistol, the GP35 was used by both Allies and Germans during World War II. It proved to be both rugged and reliable and continues in use today.

▼ ASTRA M901

Date	1927
Origin	Spain
Weight	2.1kg (4¾lb)
Barrel	16cm (6½in)
Calibre	7.63mm Mauser

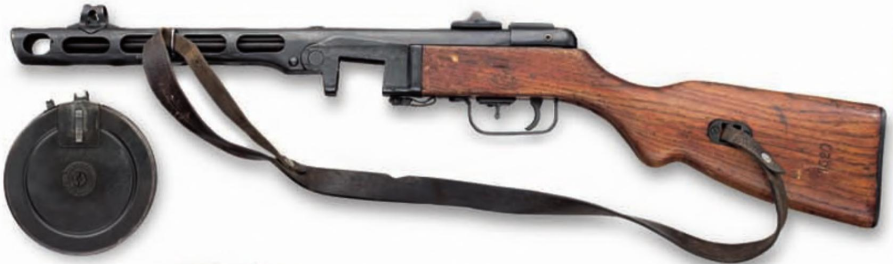
This self-loading pistol was part of the Astra 900 series, a copy of the Schnellfeuer ("Rapidfire") version of the Mauser C/96. It had an automatic-fire capability, but was difficult to control in that mode.

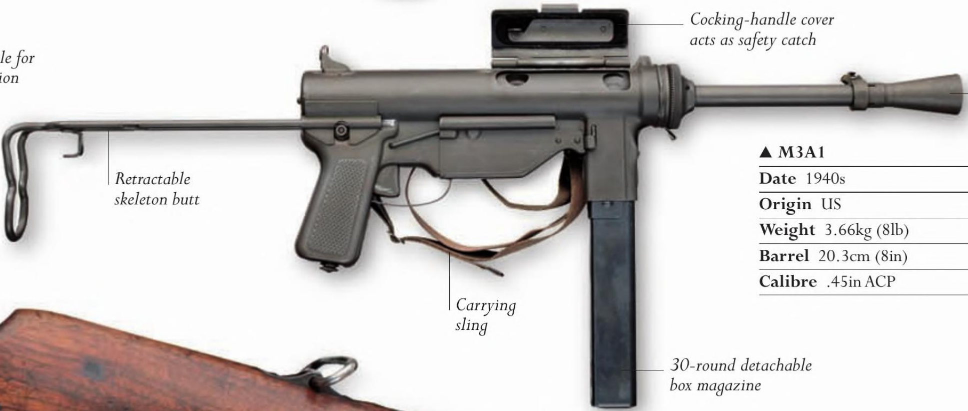

20-round fixed magazine

▶ PPSH-41

Date	1939
Origin	Soviet Union
Weight	3.5kg (7¾lb)
Barrel	27cm (10½in)
Calibre	7.62mm

Over five million examples of this sturdy and dependable weapon had been manufactured for the Red Army by the end of World War II.



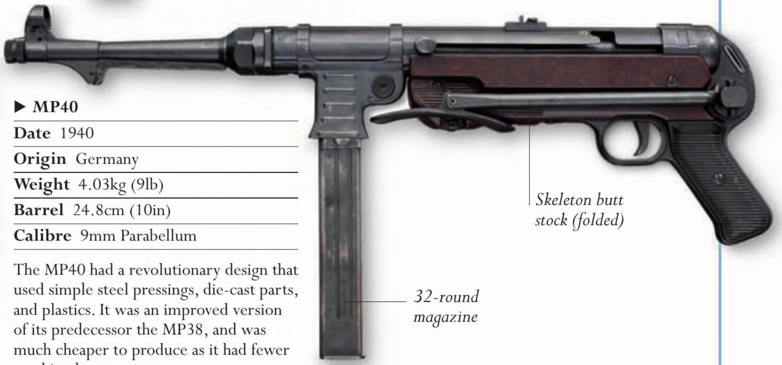

Cocking-handle cover acts as safety catch
Flash suppressor
Retractable skeleton butt
Carrying sling
30-round detachable box magazine

▲ M3A1

Date	1940s
Origin	US
Weight	3.66kg (8lb)
Barrel	20.3cm (8in)
Calibre	.45in ACP

The M3 "Grease Gun" – and the improved M3A1 version – was cheap to produce and simple to strip, clean, and maintain. It fired the same heavy pistol round used in the Colt M1911A1.

Rear sight adjustable for windage and elevation
Wooden butt stock, removable in some models

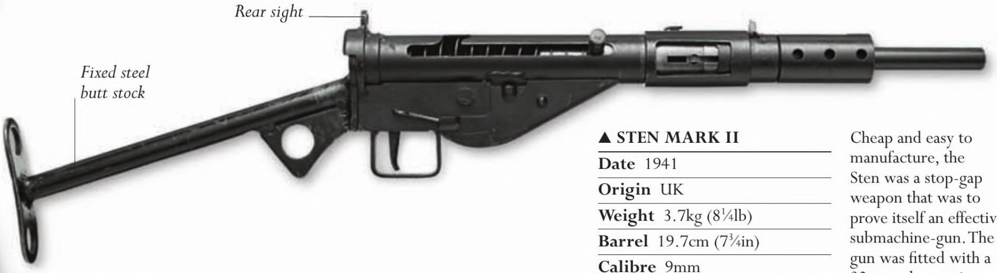

Skeleton butt stock (folded)
32-round magazine

▶ MP40

Date	1940
Origin	Germany
Weight	4.03kg (9lb)
Barrel	24.8cm (10in)
Calibre	9mm Parabellum

The MP40 had a revolutionary design that used simple steel pressings, die-cast parts, and plastics. It was an improved version of its predecessor the MP38, and was much cheaper to produce as it had fewer machined parts.

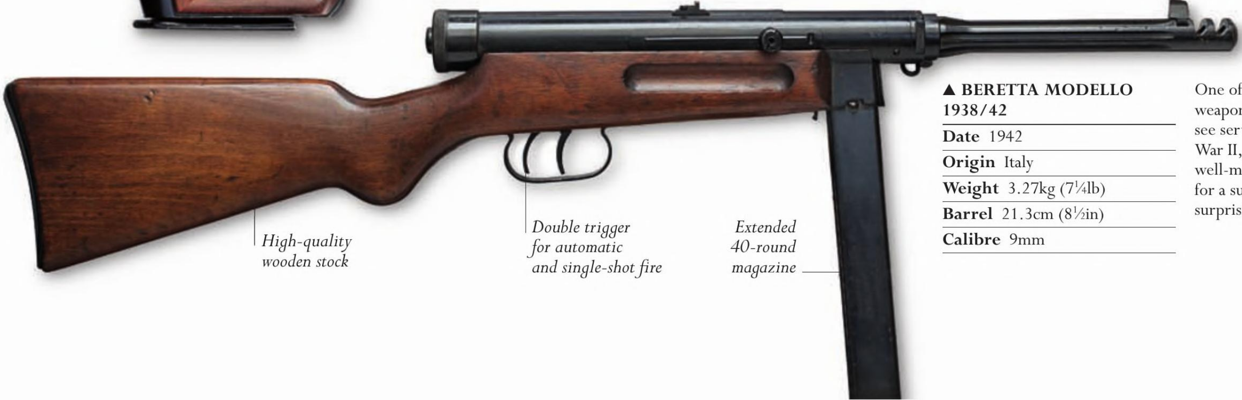
Butt houses 13-round removable magazine


Rear sight
Fixed steel butt stock

▲ STEN MARK II

Date	1941
Origin	UK
Weight	3.7kg (8¼lb)
Barrel	19.7cm (7¾in)
Calibre	9mm

Cheap and easy to manufacture, the Sten was a stop-gap weapon that was to prove itself an effective submachine-gun. The gun was fitted with a 32-round magazine.


High-quality wooden stock
Double trigger for automatic and single-shot fire
Extended 40-round magazine

▲ BERETTA MODELLO 1938/42

Date	1942
Origin	Italy
Weight	3.27kg (7¼lb)
Barrel	21.3cm (8½in)
Calibre	9mm

One of the finest weapons of its type to see service during World War II, the M38/42 was well-made, reliable, and, for a submachine-gun, surprisingly accurate.

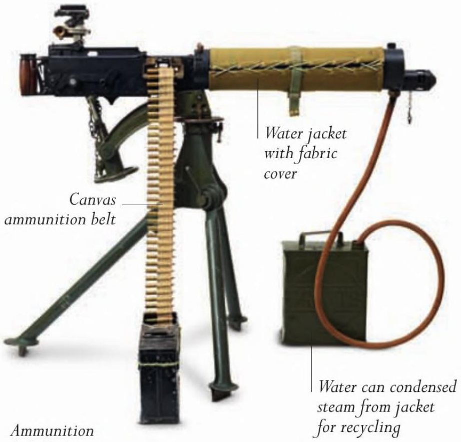
WATER- AND AIR-COOLED MACHINE-GUNS

The air-cooled machine-guns of World War II marked a shift away from the water-cooled models of World War I, although a notable exception was the tried-and-tested Vickers. Another trend was the twin development of the light machine-gun, with examples such as the Bren and the Breda, and the heavy machine-gun, exemplified by the Degtyarev DShK1938 and the Browning M2 HB. The key technological development came from Germany, however, with the introduction of the MG34. The first general-purpose machine-gun, it combined the sustained-fire role of the heavy or medium machine-gun with the portability of the light machine-gun.

▶ VICKERS MK I

Date	1912
Origin	UK
Weight	18.1kg (40lb)
Barrel	72.1cm (28½in)
Calibre	.303in

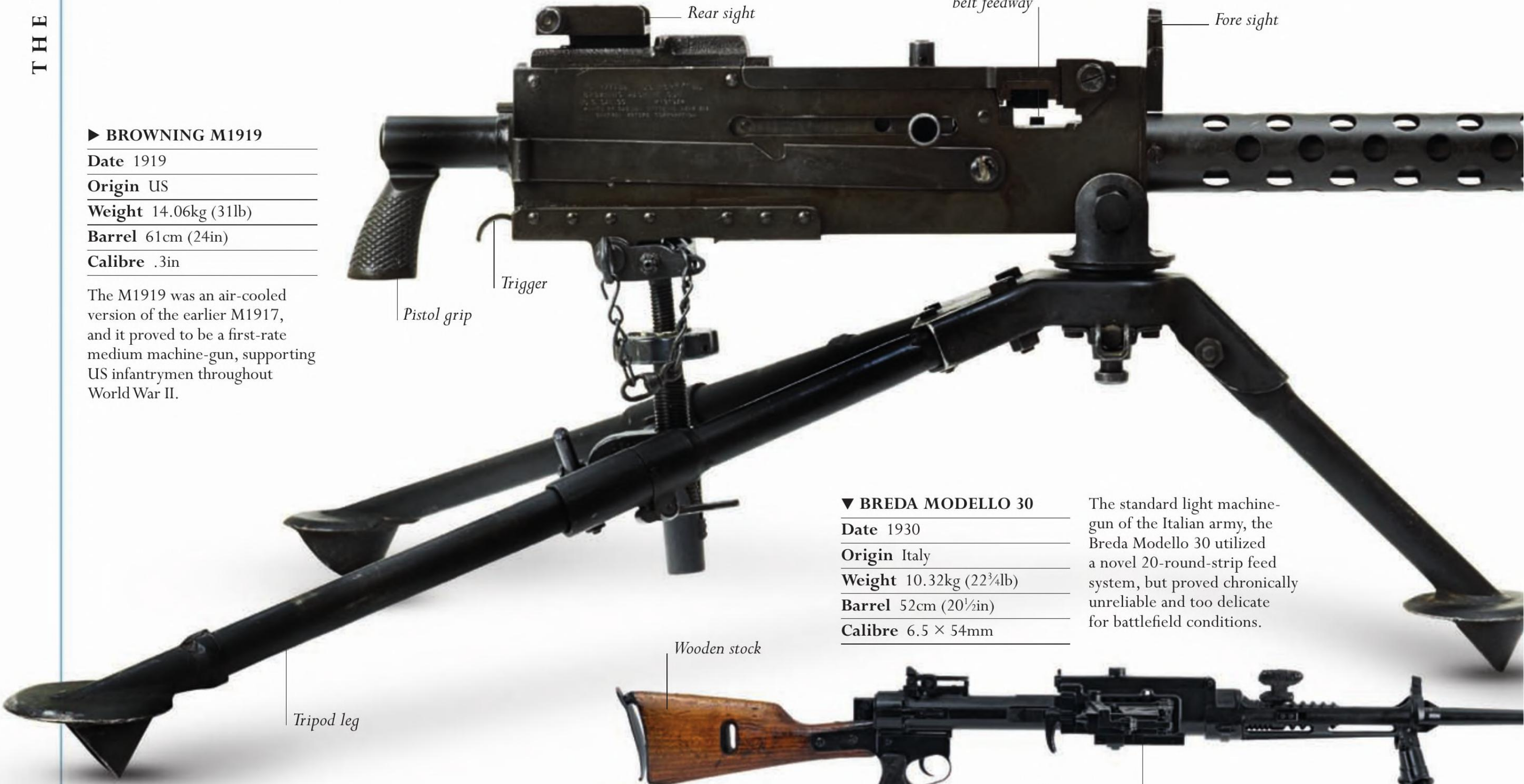
Employed in both world wars, the water-cooled Vickers was an extremely reliable medium machine-gun, and, when firing the Mk 8Z bullet, was capable of a range of up to 4.1km (2.54 miles).


Water jacket with fabric cover
Canvas ammunition belt
Water can condensed steam from jacket for recycling

▶ BROWNING M1919

Date	1919
Origin	US
Weight	14.06kg (31lb)
Barrel	61cm (24in)
Calibre	.3in

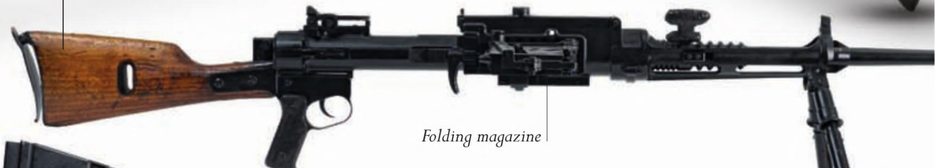
The M1919 was an air-cooled version of the earlier M1917, and it proved to be a first-rate medium machine-gun, supporting US infantrymen throughout World War II.


Rear sight
Ammunition belt feedway
Fore sight
Trigger
Pistol grip
Tripod leg

▼ BREDA MODELLO 30

Date	1930
Origin	Italy
Weight	10.32kg (22¾lb)
Barrel	52cm (20½in)
Calibre	6.5 × 54mm

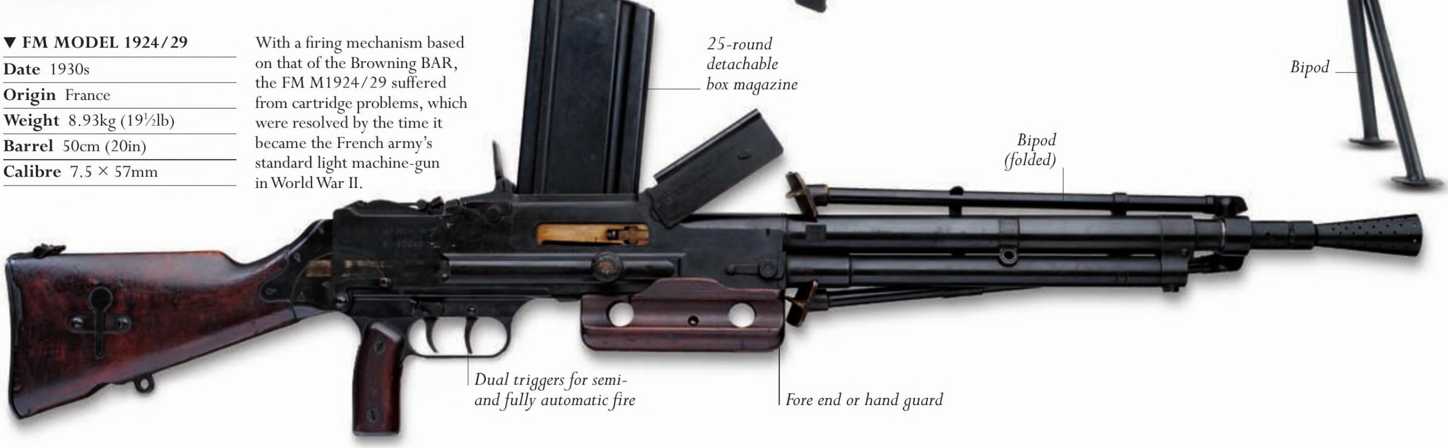
The standard light machine-gun of the Italian army, the Breda Modello 30 utilized a novel 20-round-strip feed system, but proved chronically unreliable and too delicate for battlefield conditions.

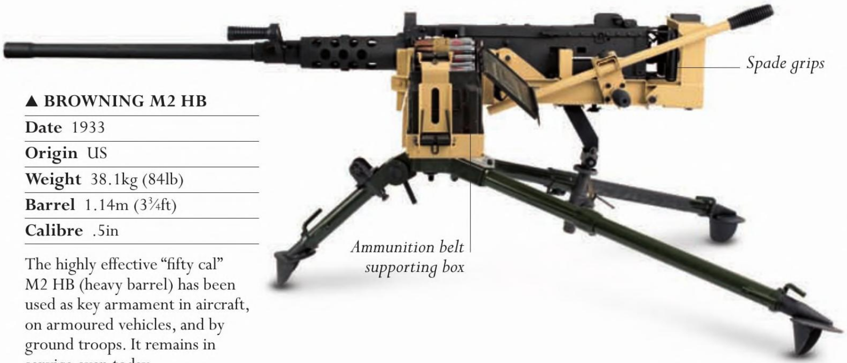

Wooden stock
Folding magazine
Bipod

▼ FM MODEL 1924/29

Date	1930s
Origin	France
Weight	8.93kg (19½lb)
Barrel	50cm (20in)
Calibre	7.5 × 57mm

With a firing mechanism based on that of the Browning BAR, the FM M1924/29 suffered from cartridge problems, which were resolved by the time it became the French army's standard light machine-gun in World War II.


25-round detachable box magazine
Bipod (folded)
Dual triggers for semi- and fully automatic fire
Fore end or hand guard

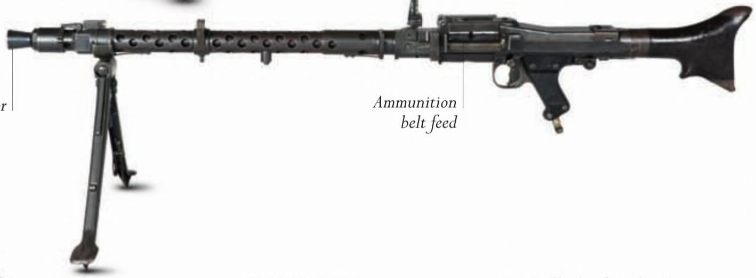

Spade grips
Ammunition belt supporting box

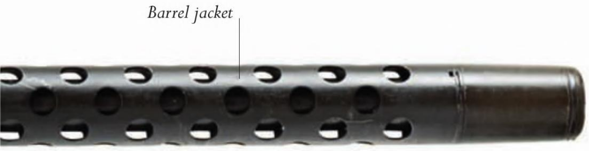
▲ BROWNING M2 HB
Date 1933
Origin US
Weight 38.1kg (84lb)
Barrel 1.14m (3¾ft)
Calibre .5in

The highly effective "fifty cal" M2 HB (heavy barrel) has been used as key armament in aircraft, on armoured vehicles, and by ground troops. It remains in service even today.

▼ MG34
Date 1935
Origin Germany
Weight 11.5kg (25¼lb)
Barrel 62.7cm (24¾in)
Calibre 7.92 × 57mm

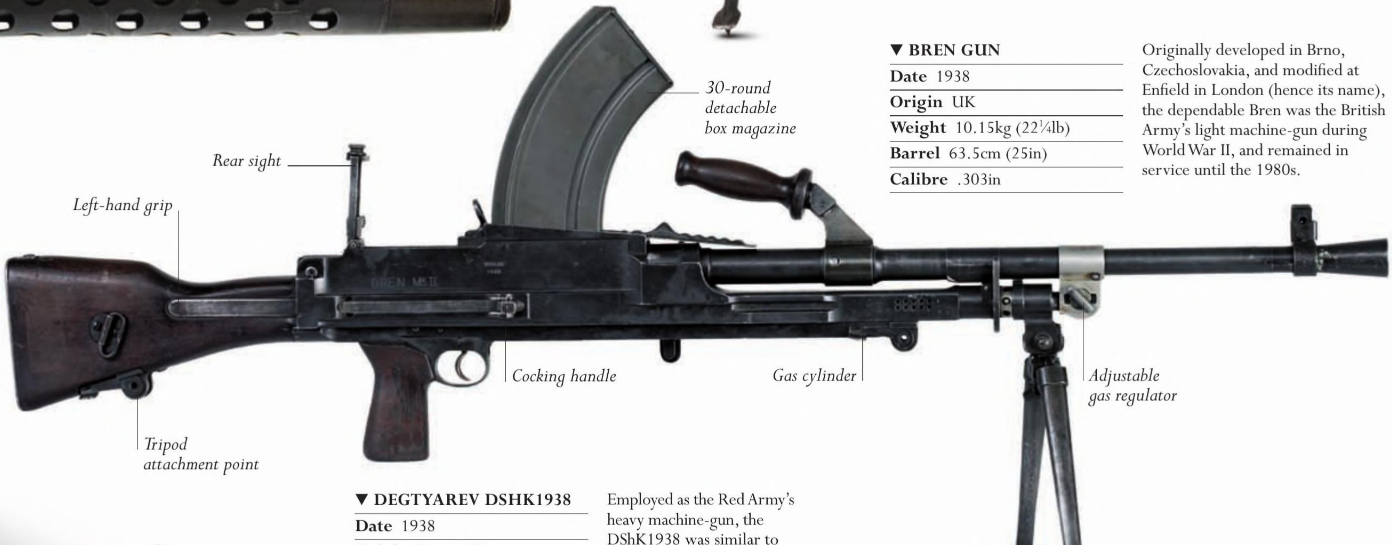
The MG34 was a revolutionary design – light, yet robust enough to deliver sustained fire at 900 rounds per minute. However, it was difficult and expensive to manufacture and was subsequently replaced by the MG42.


Flash suppressor
Ammunition belt feed


Barrel jacket

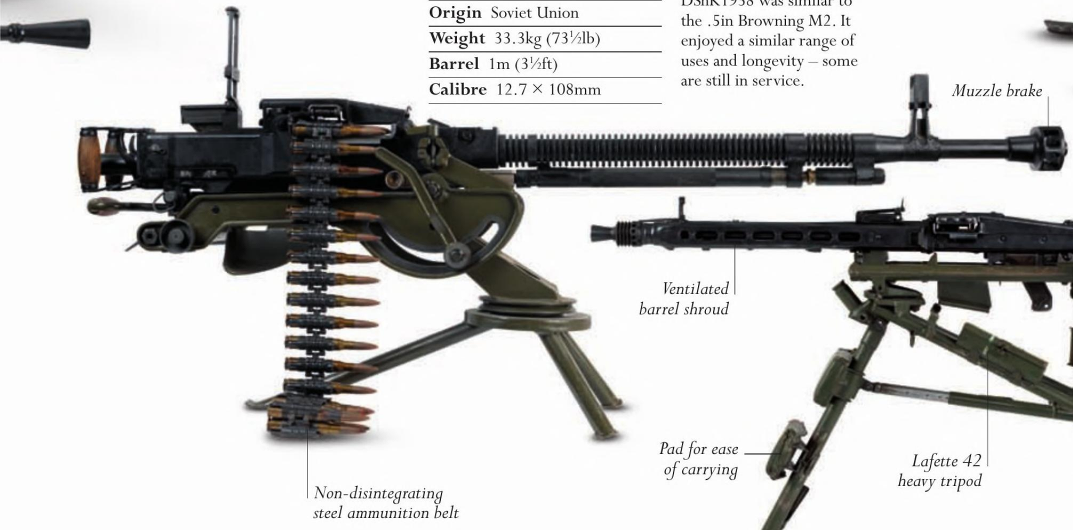
▼ BREN GUN
Date 1938
Origin UK
Weight 10.15kg (22¼lb)
Barrel 63.5cm (25in)
Calibre .303in

Originally developed in Brno, Czechoslovakia, and modified at Enfield in London (hence its name), the dependable Bren was the British Army's light machine-gun during World War II, and remained in service until the 1980s.


30-round detachable box magazine
Rear sight
Left-hand grip
Cocking handle
Gas cylinder
Adjustable gas regulator
Tripod attachment point

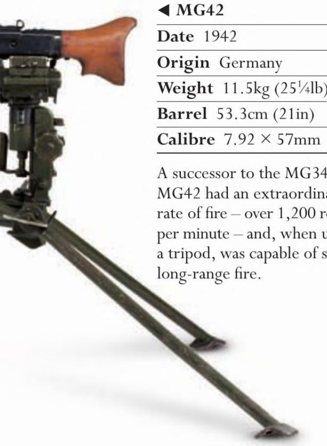
▼ DEGTYAREV DSHK1938
Date 1938
Origin Soviet Union
Weight 33.3kg (73½lb)
Barrel 1m (3½ft)
Calibre 12.7 × 108mm

Employed as the Red Army's heavy machine-gun, the DShK1938 was similar to the .5in Browning M2. It enjoyed a similar range of uses and longevity – some are still in service.


Muzzle brake
Non-disintegrating steel ammunition belt

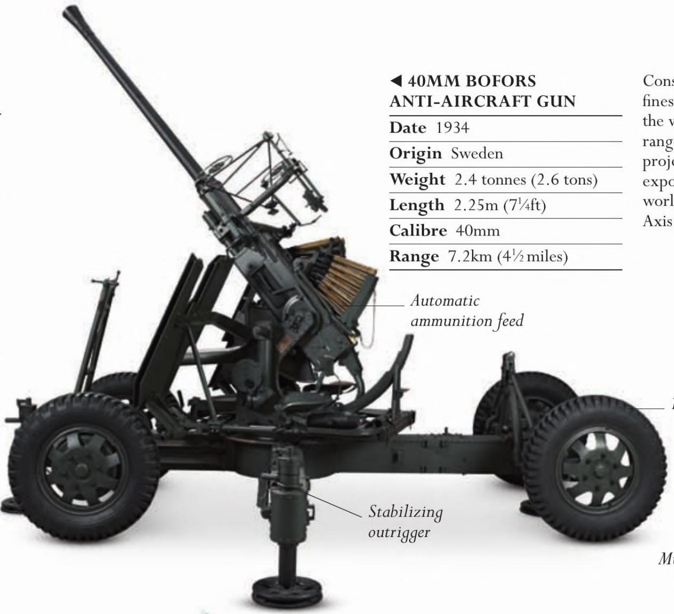
◀ MG42
Date 1942
Origin Germany
Weight 11.5kg (25¼lb)
Barrel 53.3cm (21in)
Calibre 7.92 × 57mm

A successor to the MG34, the MG42 had an extraordinarily high rate of fire – over 1,200 rounds per minute – and, when used with a tripod, was capable of sustained long-range fire.


Ventilated barrel shroud
Pad for ease of carrying
Lafette 42 heavy tripod

ARTILLERY

The story of artillery in World War II was one of evolution from the firepower of the previous world war. Field pieces gradually became more mobile, ranges increased, and radio communications improved tactical flexibility. One new development, however, was the widespread introduction of rocket artillery, such as the German Nebelwerfer, which were able to cover large areas with a carpet of high explosive. Artillery continued to play a key role in both attack and defence, and this was the reason that the Soviet armed forces described it as the "Red God of War".



◀ 40MM BOFORS ANTI-AIRCRAFT GUN

Date 1934
Origin Sweden
Weight 2.4 tonnes (2.6 tons)
Length 2.25m (7¼ft)
Calibre 40mm
Range 7.2km (4½ miles)

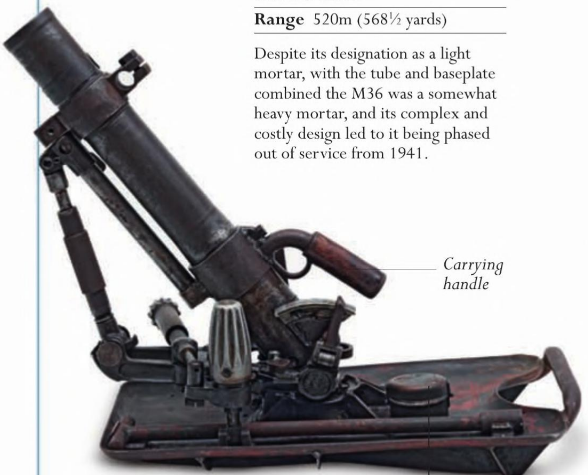
Considered to be one of the finest anti-aircraft guns of the war, combining accuracy, range, and a decent-sized projectile, the Bofors was exported throughout the world, and used by both Axis and Allied armies.

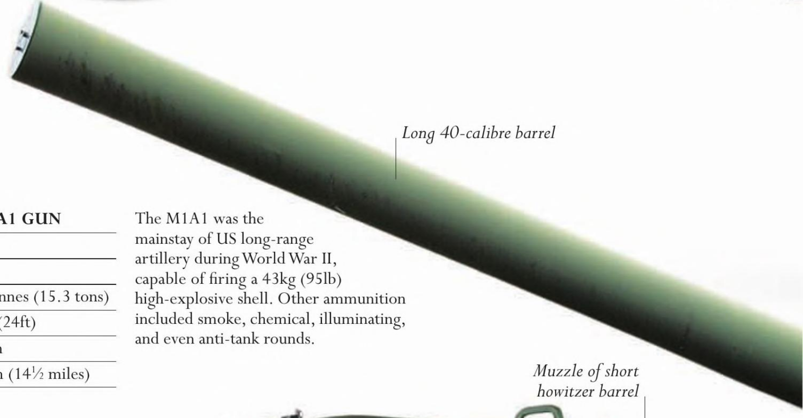
Muzzle brake

▼ 50MM LIGHT MORTAR 36

Date 1936
Origin Germany
Weight 14kg (31lb)
Calibre 50mm
Range 520m (568½ yards)

Despite its designation as a light mortar, with the tube and baseplate combined the M36 was a somewhat heavy mortar, and its complex and costly design led to it being phased out of service from 1941.

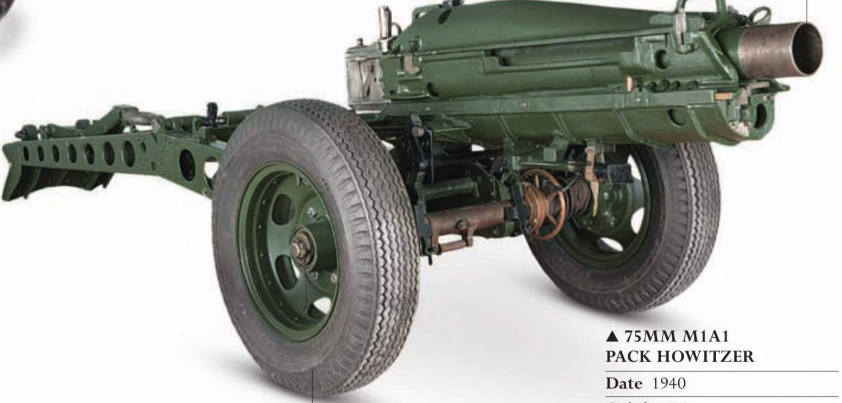




▶ 155MM M1A1 GUN

Date 1941
Origin US
Weight 13.9 tonnes (15.3 tons)
Length 7.36m (24ft)
Calibre 155mm
Range 23.22km (14½ miles)

The M1A1 was the mainstay of US long-range artillery during World War II, capable of firing a 43kg (95lb) high-explosive shell. Other ammunition included smoke, chemical, illuminating, and even anti-tank rounds.

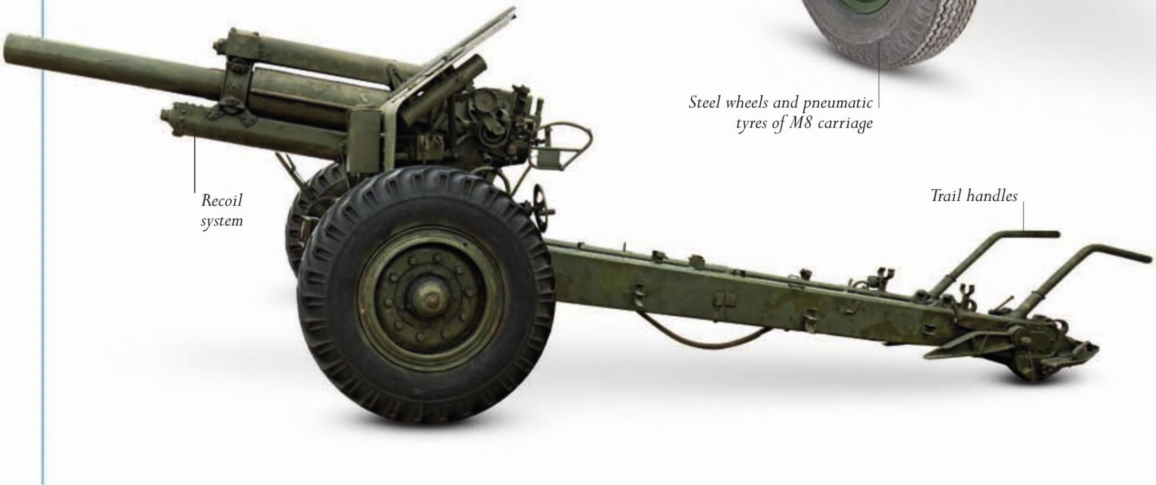


Muzzle of short howitzer barrel
Steel wheels and pneumatic tyres of M8 carriage

▼ 122MM M1938 HOWITZER

Date 1939
Origin Soviet Union
Weight 3.1 tonnes (3.4 tons)
Length 5.9m (19¼ft)
Calibre 122mm
Range 11.8km (7½ miles)

Also known as the M30, this field howitzer was a mainstay of the Red Army's artillery division. Maintained by a crew of eight, it was capable of a rate of fire of six rounds per minute.



▲ 75MM M1A1 PACK HOWITZER

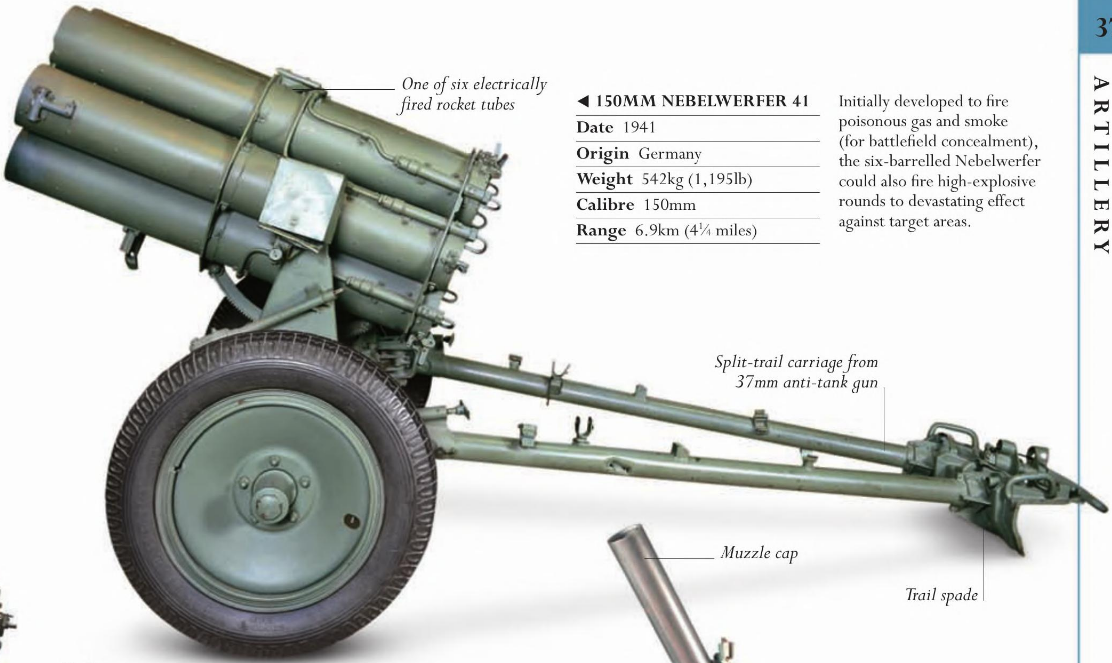
Date 1940
Origin US
Weight 653kg (1,440lb)
Length 3.68m (12ft)
Calibre 75mm
Range 8.79km (5½ miles)

Developed for use on rough terrain, where it could be broken down into separate pieces to be carried by pack animals, the lightweight M1A1 howitzer was also successfully assigned to US airborne forces.

▼ 25-POUNDER GUN-HOWITZER (MK II)

Date	1940
Origin	UK
Weight	1.8 tonnes (2 tons)
Length	4.6m (15ft)
Calibre	88mm
Range	12.25km (7¾ miles)

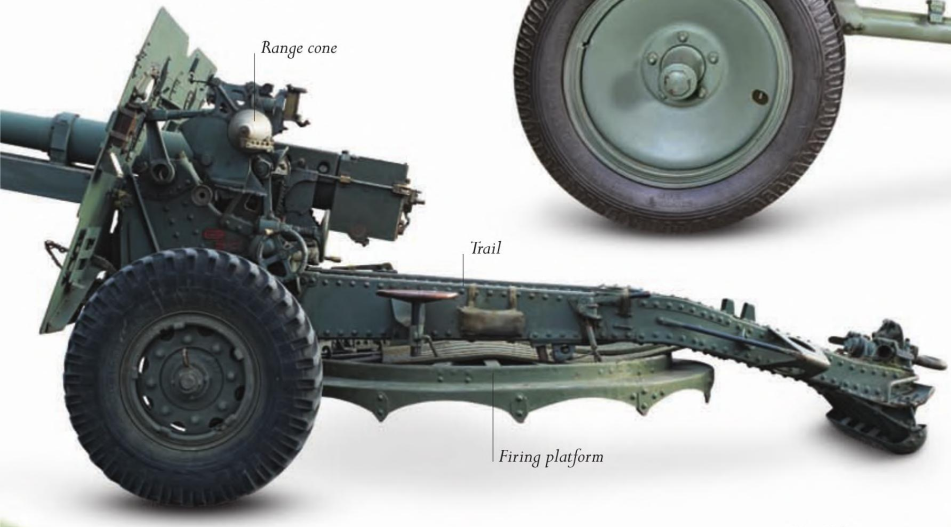
An effective compromise between the gun and the howitzer, the 25-pounder came into its own in the North African Campaign, where it was pressed into service as an ad hoc anti-tank gun.

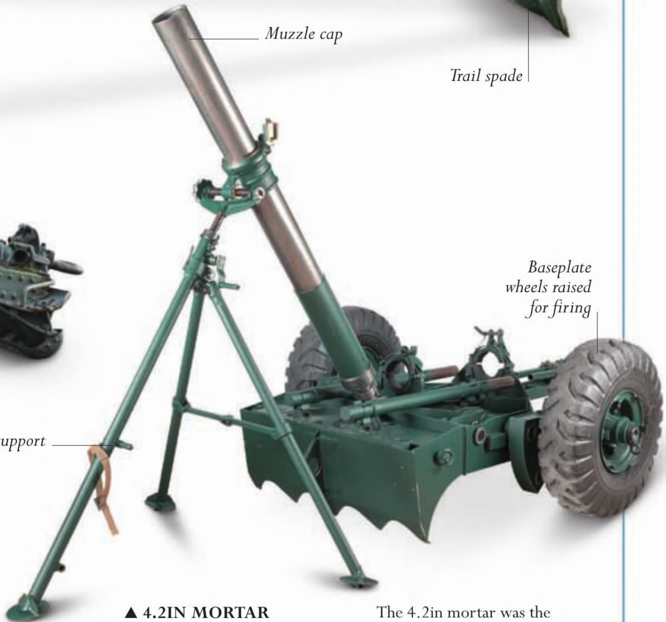

One of six electrically fired rocket tubes
Split-trail carriage from 37mm anti-tank gun
Trail spade

◀ 150MM NEBELWERFER 41

Date	1941
Origin	Germany
Weight	542kg (1,195lb)
Calibre	150mm
Range	6.9km (4¼ miles)

Initially developed to fire poisonous gas and smoke (for battlefield concealment), the six-barrelled Nebelwerfer could also fire high-explosive rounds to devastating effect against target areas.

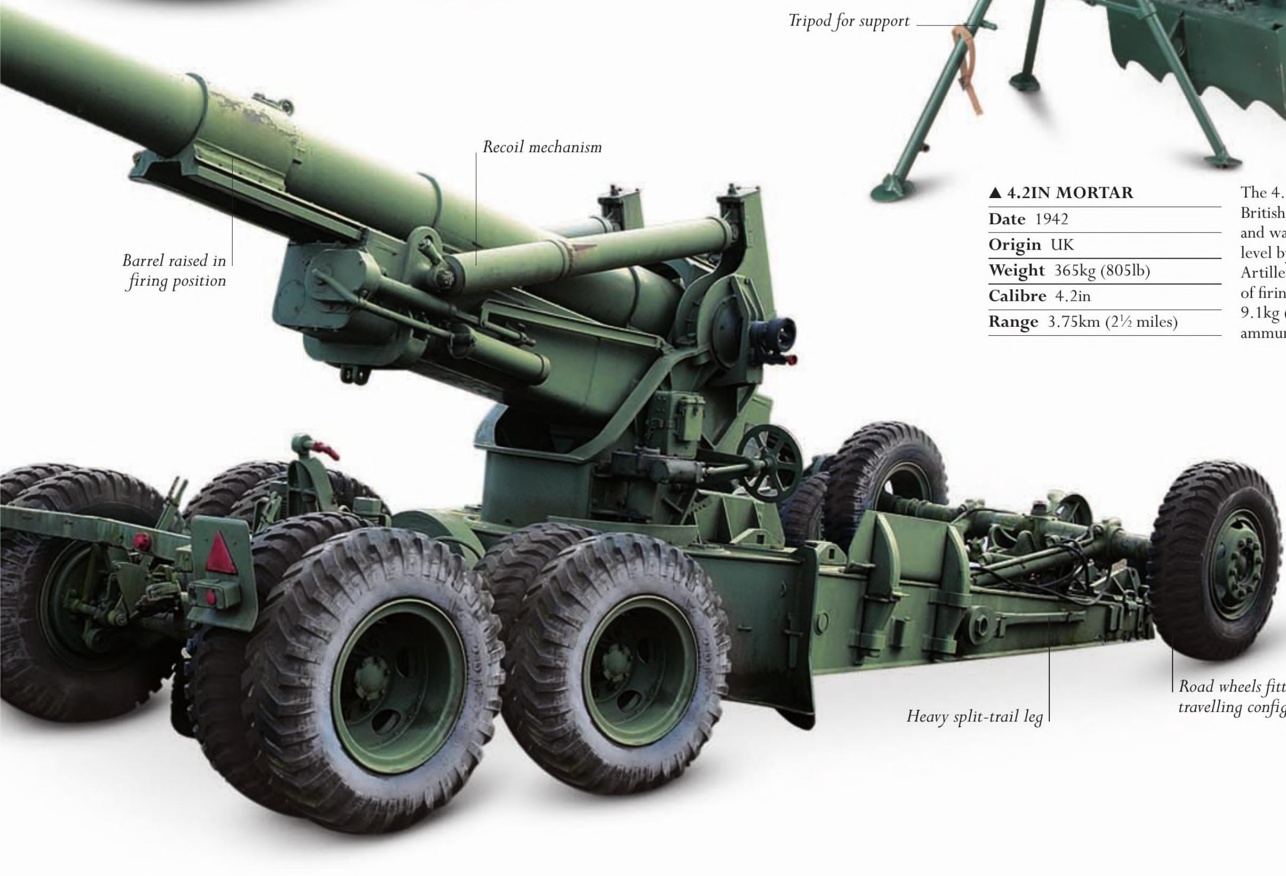

Range cone
Trail
Firing platform

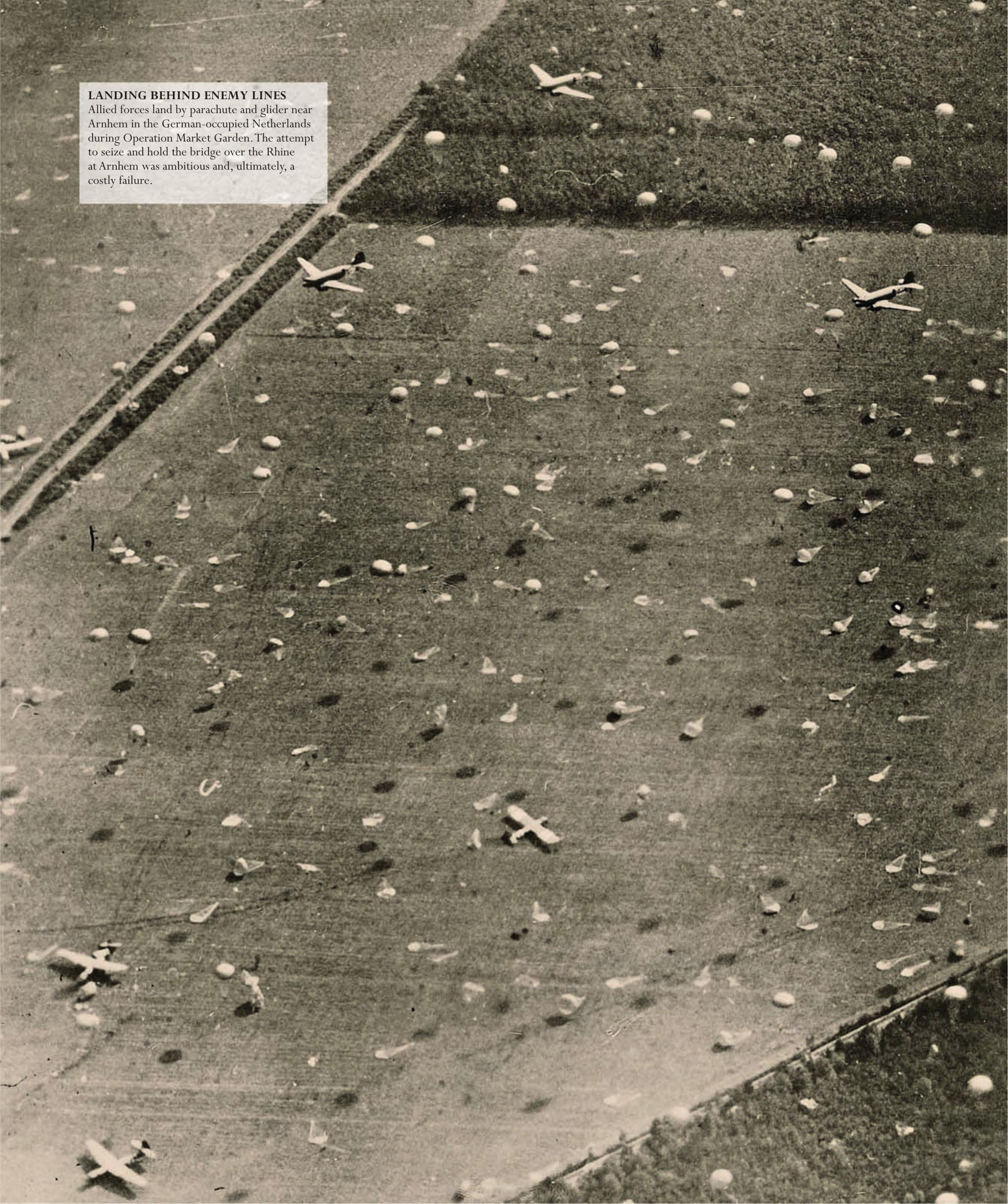

Muzzle cap
Baseplate wheels raised for firing
Tripod for support

▲ 4.2IN MORTAR

Date	1942
Origin	UK
Weight	365kg (805lb)
Calibre	4.2in
Range	3.75km (2½ miles)

The 4.2in mortar was the British Army's heavy mortar, and was manned at divisional level by crews from the Royal Artillery. It was capable of firing up to 20 rounds of 9.1kg (20lb) high-explosive ammunition in a minute.


Recoil mechanism
Barrel raised in firing position
Heavy split-trail leg
Road wheels fitted in travelling configuration



LANDING BEHIND ENEMY LINES
Allied forces land by parachute and glider near Arnhem in the German-occupied Netherlands during Operation Market Garden. The attempt to seize and hold the bridge over the Rhine at Arnhem was ambitious and, ultimately, a costly failure.

AIRBORNE ASSAULT

OPERATION MARKET GARDEN

Launched in September 1944, Operation Market Garden was the largest airborne assault to date, aimed at seizing tactical objectives in the Netherlands. It might have shortened the war; but its successes and eventual failure showed both the strengths and weaknesses of airborne forces.

In August 1944, British and American airborne troops were placed under unified command as the First Allied Airborne Army. General Bernard Montgomery of the British Army planned to use this force to open a path through the German-occupied Netherlands and into northern Germany. Airborne troops, both parachute and glider infantry, were to seize and hold a series of bridges and canals to allow the British 30th Corps, advancing from the Allied front line, to move towards the German border.

The scale of the airborne operation was unprecedented. Taking off from England on 17 September, the first wave involved over 20,000 troops packed into more than 1,500 transport aircraft and 500 gliders. Allied air supremacy allowed this aerial armada to fly to its target areas in daylight, dropping parachutists and their equipment with varied accuracy. The gliders, towed by "tug" aircraft, also mostly landed safely. But once on the ground, the airborne forces were in a risky position. Although some heavy equipment was landed with them, they were unsupported infantry deep inside hostile territory. Once the enemy recovered from the surprise of the initial assault, the lightly armed troops would have to resist counterattacks until the arrival of the British corps' tanks and artillery.

US 101st Airborne Division landed near Eindhoven, closest to the Allied front line. They quickly took four of the five bridges assigned to them and were joined by the advancing British armoured forces on 18 September. US 82nd Airborne were assigned responsibility for seizing crossings of the Maas and Waal Rivers. Engaged in heavy fighting, they succeeded in repelling German counterattacks but failed to take the vital bridge at Nijmegen; meanwhile a second round of airdrops and glider landings that should have brought reinforcements was delayed in poor weather. The British corps successfully made contact with 82nd Airborne on 19 September, but the bridge was not taken until the next day, after a high-casualty river crossing by troops in rowing boats.

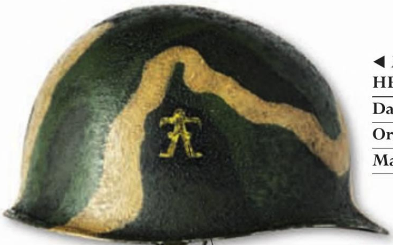
BEST-LAID PLANS

These delays placed Britain's First Airborne Division, attempting to take the final bridge over the Rhine at Arnhem, in a desperate situation. The paratroops had landed too far from their target; with radio and navigation problems, they lost coherence in the advance towards Arnhem, and only one battalion reached the bridge. German counterattacks, meanwhile, were ferocious. The presence of two SS panzer divisions in the area had been reported by intelligence sources before the operation, but the information had been ignored: now, infantry divisions with only light artillery support found themselves fighting for their lives against German tanks.

The arrival of the Polish Parachute Brigade to reinforce the British was delayed until 21 September, and even then they were dropped in the wrong place. After heroic resistance, the battalion at the bridge surrendered, on the same day. On 25 September, efforts turned to evacuating surviving soldiers across the Rhine. In total 2,398 were saved, but 1,485 had been killed and 6,414 taken prisoner. The operation had failed.

AIRBORNE FORCES UNIFORM AND KIT

World War II witnessed an expansion in the use of parachute-equipped troops. The strength of airborne formations was their strategic mobility, but once the paratrooper landed he became a heavily burdened infantryman, lacking both tactical mobility and firepower. Miniaturized motorcycles and simple folding bicycles were used to improve his capability but had limited success. Light mortars and shoulder-launched anti-tank weapons, used by conventional infantry, provided the paratrooper with portable "artillery".


D-ring chinstrap holder
"Gingerbread Man" emblem

◀ M2 PARATROOPER HELMET

Date 1942

Origin US

Material Steel

The airborne helmet had a D-ring chinstrap holder and a spray-paint camouflage, applied by its owner. The "Gingerbread Man" was the emblem of the 509th Airborne Battalion.

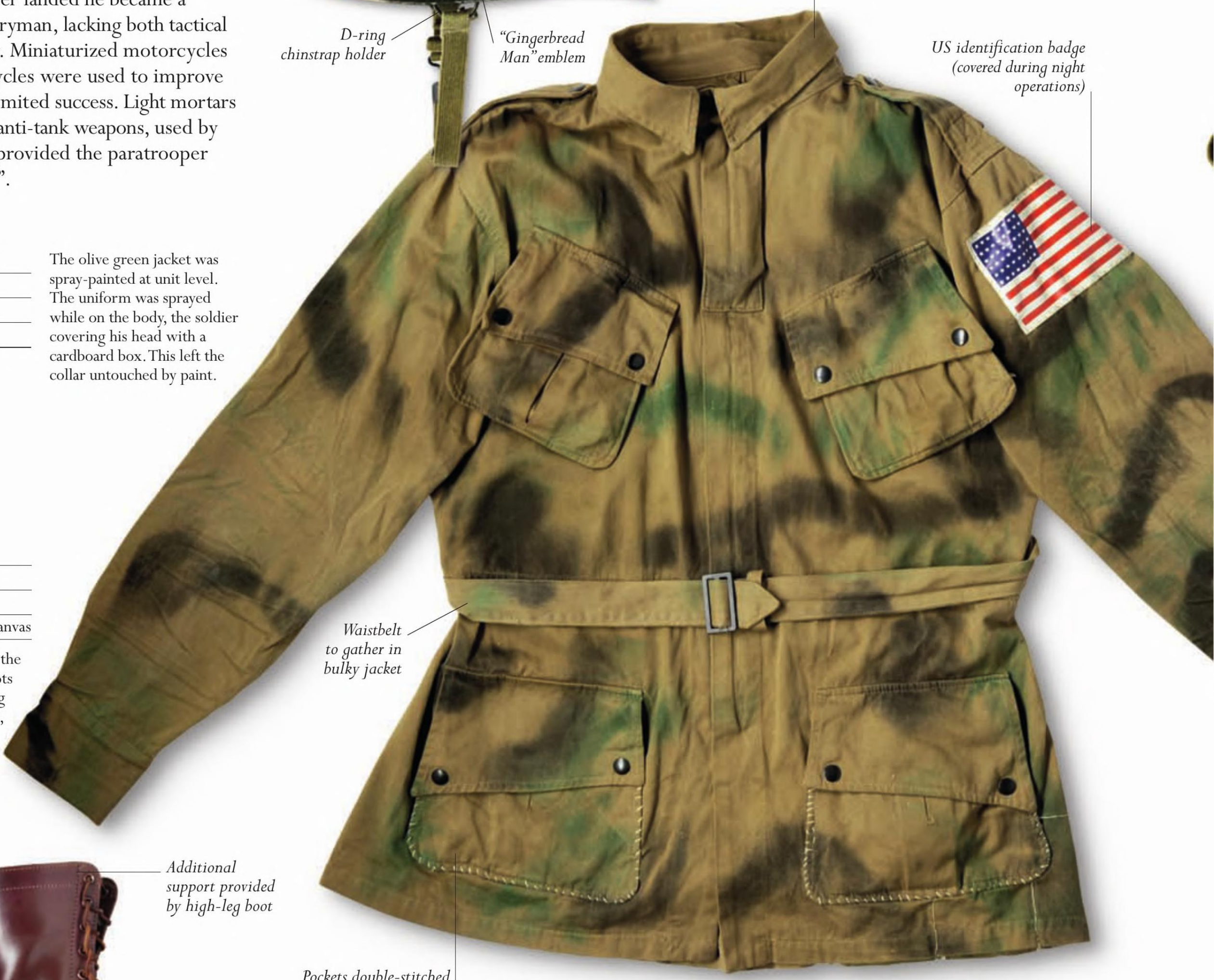
▶ M1942 JUMP JACKET

Date 1942

Origin US

Material Cotton poplin

The olive green jacket was spray-painted at unit level. The uniform was sprayed while on the body, the soldier covering his head with a cardboard box. This left the collar untouched by paint.


Unsprayed collar
US identification badge (covered during night operations)
Waistbelt to gather in bulky jacket
Pockets double-stitched to prevent ripping when carrying grenades

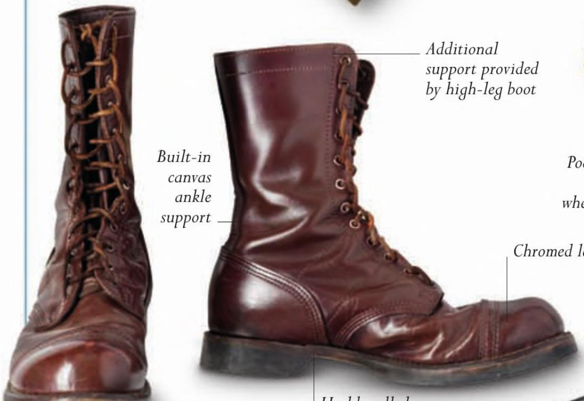
▼ JUMP BOOTS

Date 1942

Origin US

Material Leather, rubber, canvas

The coveted status symbol of the US airborne forces, jump boots were designed for parachuting safety, with reinforced toecaps, internal ankle supports, and a bevelled heel to prevent the heel snagging on the uneven aircraft floor.


Additional support provided by high-leg boot
Built-in canvas ankle support
Chromed leather
Heel bevelled backwards

▼ M1A1 CARBINE

Date 1942

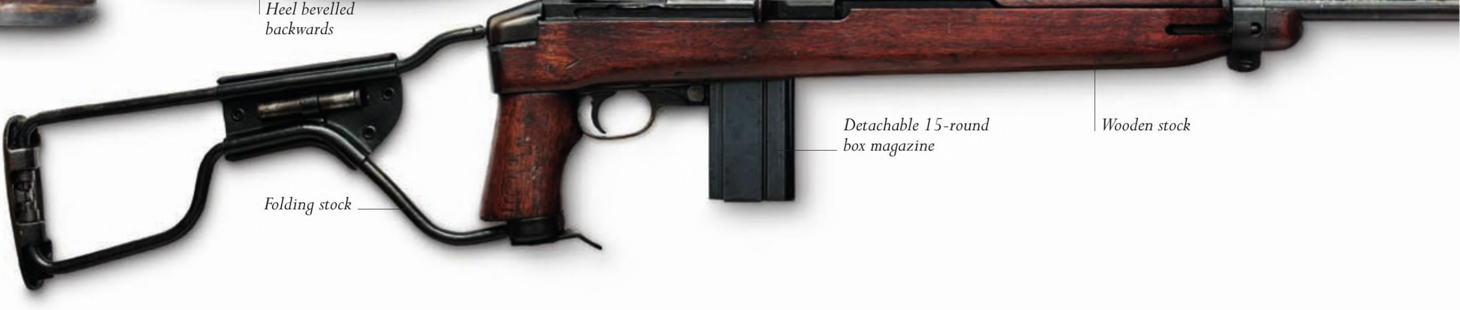
Origin US

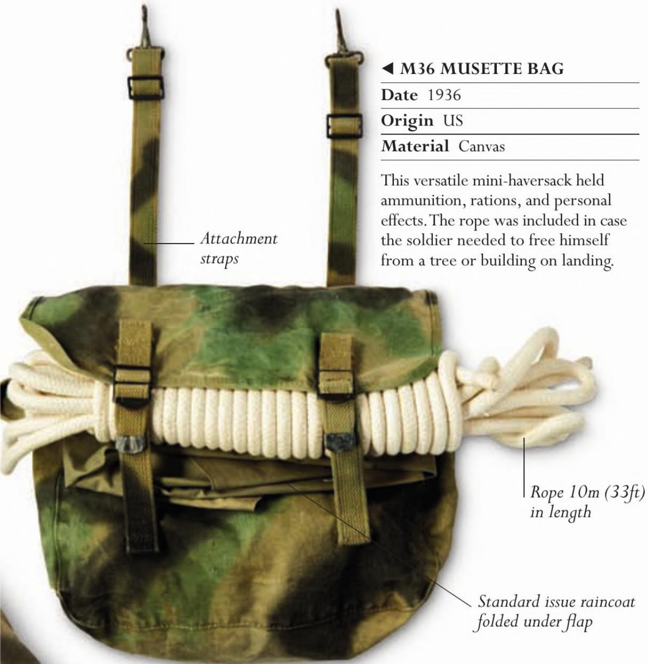
Weight 2.36kg (5¼lb)

Barrel 45.7cm (18in)

Calibre .3in

The M1 Carbine had already proved to be popular with soldiers who needed a lightweight weapon. For airborne forces, this special M1A1 variant was produced, complete with a folding stock for use during parachute drops.


Rear sight
Detachable 15-round box magazine
Wooden stock
Folding stock


Attachment straps
Rope 10m (33ft) in length
Standard issue raincoat folded under flap

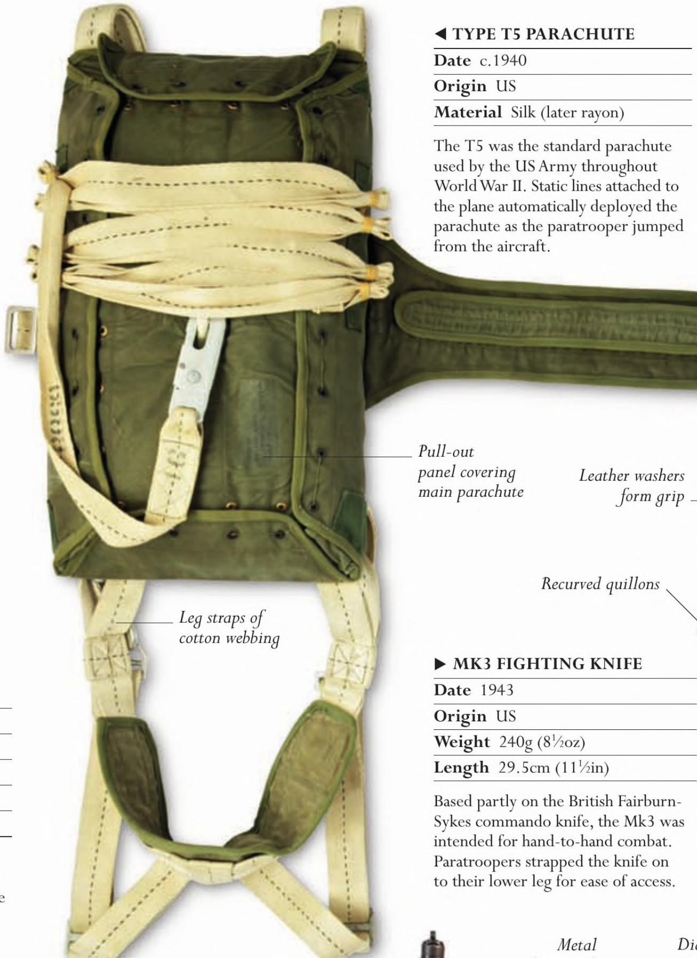
◀ M36 MUSETTE BAG

Date 1936

Origin US

Material Canvas

This versatile mini-haversack held ammunition, rations, and personal effects. The rope was included in case the soldier needed to free himself from a tree or building on landing.


Pull-out panel covering main parachute
Leg straps of cotton webbing

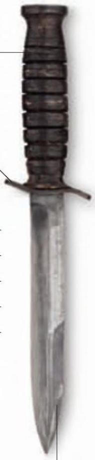
◀ TYPE T5 PARACHUTE

Date c.1940

Origin US

Material Silk (later rayon)

The T5 was the standard parachute used by the US Army throughout World War II. Static lines attached to the plane automatically deployed the parachute as the paratrooper jumped from the aircraft.


Leather washers form grip
Recurved quillons
Diamond-section blade

▶ MK3 FIGHTING KNIFE

Date 1943

Origin US

Weight 240g (8½oz)

Length 29.5cm (11½in)

Based partly on the British Fairburn-Sykes commando knife, the Mk3 was intended for hand-to-hand combat. Paratroopers strapped the knife on to their lower leg for ease of access.

▼ FG42 AUTOMATIC RIFLE

Date 1943

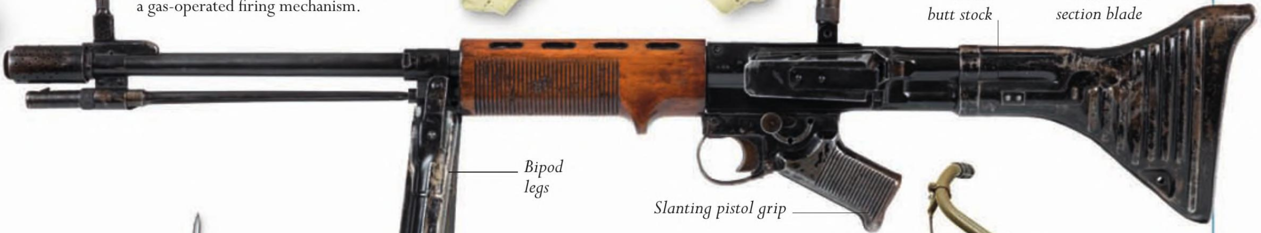
Origin Germany

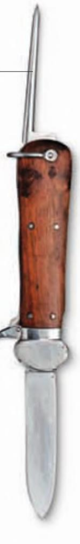
Weight 4.53kg (10lb)

Barrel 50.2cm (19¾in)

Calibre 7.9mm

The FG42 was a fully automatic weapon designed to provide long-range firepower to paratroopers on the ground. It pioneered a "straight-line" butt-to-muzzle layout and employed a gas-operated firing mechanism.


Folding sight
Metal butt stock
Bipod legs
Slanting pistol grip



▶ AIRBORNE GRAVITY KNIFE

Date 1937

Origin Germany

Weight 350g (12½oz)

Length 25.3cm (10in)

Issued to German paratroopers, this knife could be opened with one hand. When the operating lever was opened, the blade fell forwards due to gravity. It was intended primarily to help the soldier free himself from a tangled parachute harness.

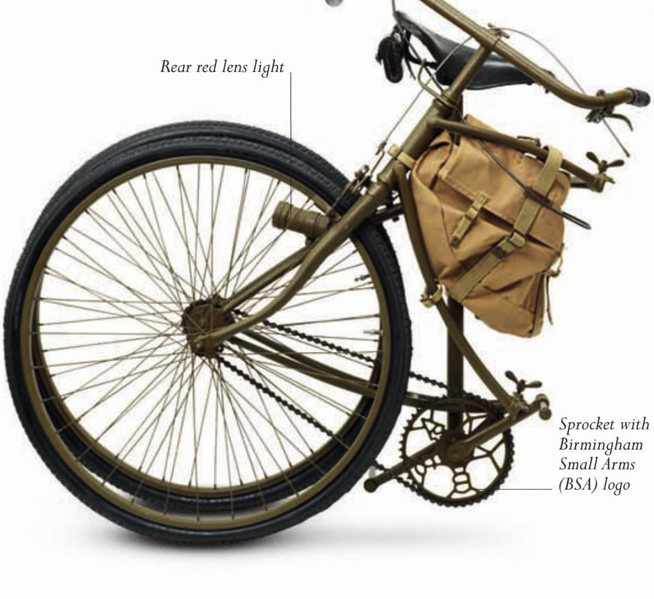
▶ BSA FOLDING BICYCLE

Date 1943

Origin UK

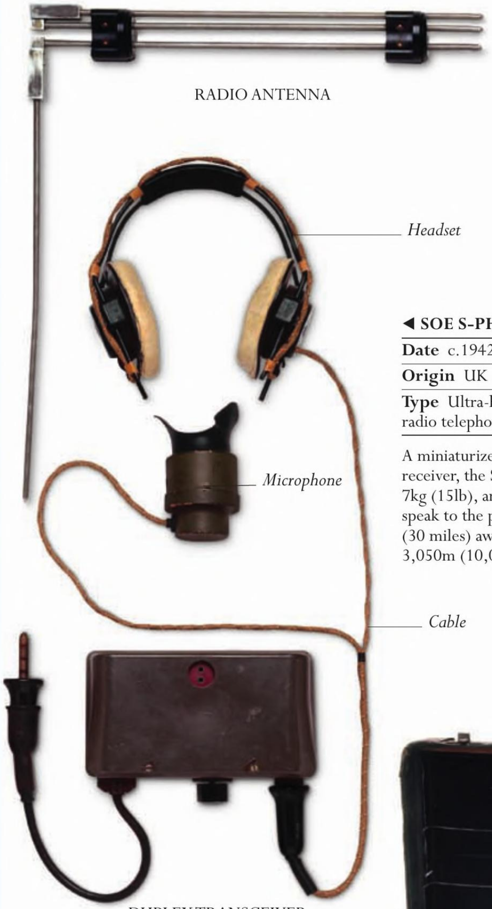
Weight (Frame) 2kg (4½lb)

The armed forces had used folding bicycles extensively during World War I, but this lightweight model was designed especially for commandos and airborne forces, to provide them some much-needed mobility.


Rear red lens light
Sprocket with Birmingham Small Arms (BSA) logo

RESISTANCE WEAPONS AND EQUIPMENT

Formed in July 1940, the British Special Operations Executive (SOE) was given the task of conducting irregular warfare throughout German-occupied Europe, providing support to local resistance movements. SOE placed a premium on lightweight, covert communications equipment, so that when its agents were operating behind enemy lines they could maintain contact with Britain. There was also a requirement for stealth weapons that could silently eliminate sentries or assassinate selected individuals. SOE was subsequently joined in its espionage operations by the American Office for Strategic Services (OSS), which placed a similar emphasis on specialist weapons.


RADIO ANTENNA
Headset
Microphone
Cable
DUPLEX TRANSCEIVER

◀ SOE S-PHONE TRANSCEIVER

Date c.1942

Origin UK

Type Ultra-high frequency duplex radio telephone

A miniaturized transmitter and receiver, the S-Phone weighed just 7kg (15lb), and enabled an agent to speak to the pilot of an aircraft 48km (30 miles) away at a height of up to 3,050m (10,000ft).

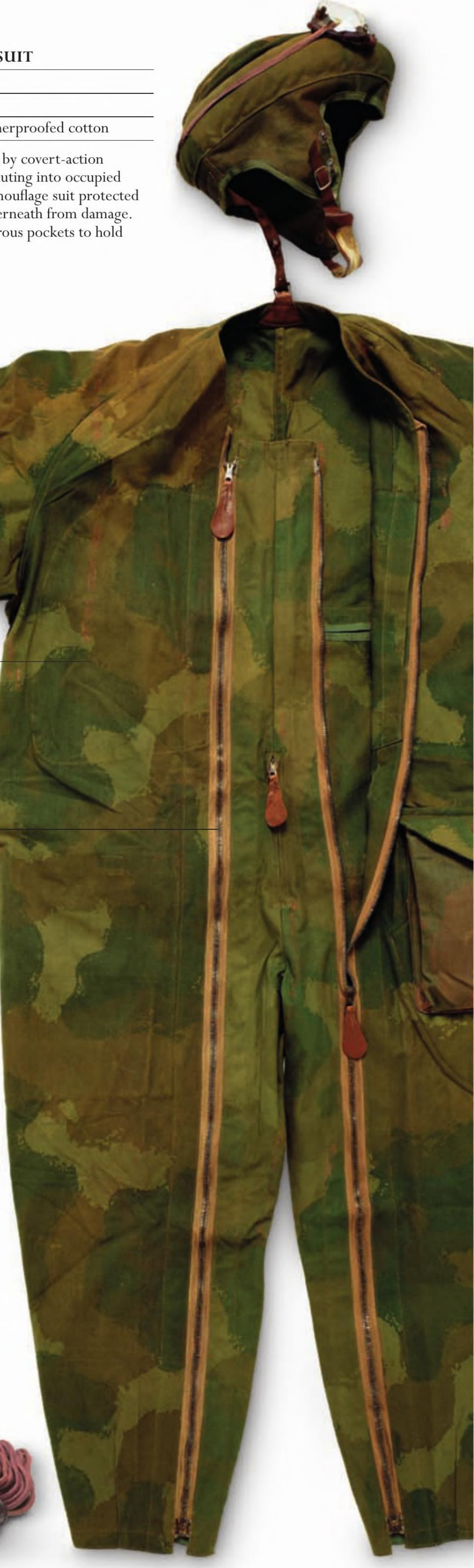
▶ SOE JUMP SUIT

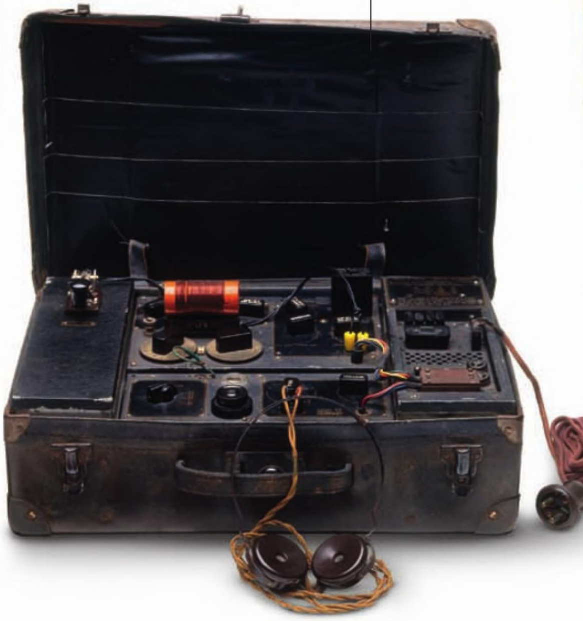
Date 1941

Origin UK

Material Weatherproofed cotton

Designed for use by covert-action personnel parachuting into occupied territory, the camouflage suit protected the clothing underneath from damage. It also had numerous pockets to hold vital equipment.


Inner pockets to hold kit securely
Full-length zip to allow quick removal of jump suit


Radio concealed in leather suitcase

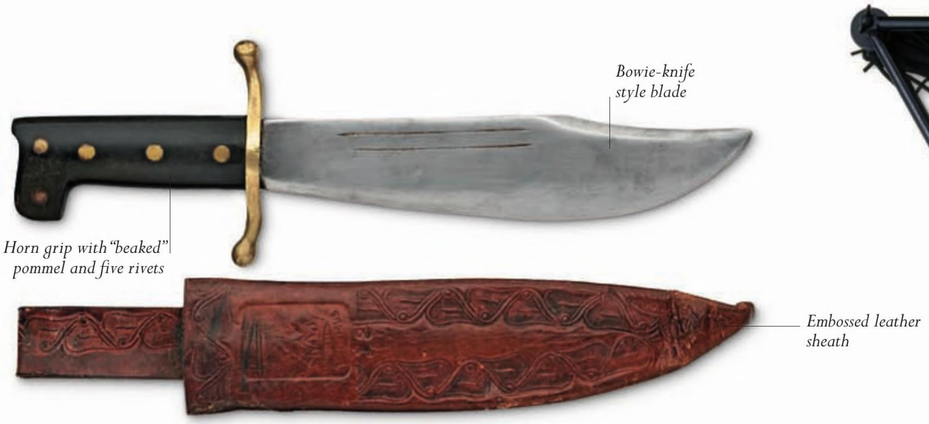
▶ SOE TYPE 3 (MK II) SUITCASE RADIO

Date c.1942

Origin UK

Type Portable transmitter/receiver station

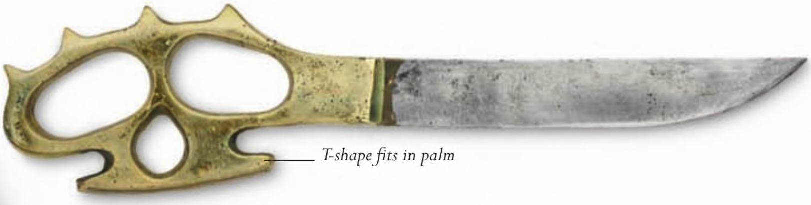
Designed for agents working in enemy territory, the radio could transmit and receive messages to ranges of up to 800km (500 miles). It contained a modular receiver, transmitter, power supply unit, and miniature Morse key.


Bowie-knife style blade
Horn grip with "beaked" pommel and five rivets
Embossed leather sheath

▲ V44 SURVIVAL KNIFE

Date	1934
Origin	US
Weight	1.1kg (2½lb)
Length	34.5cm (13½in)

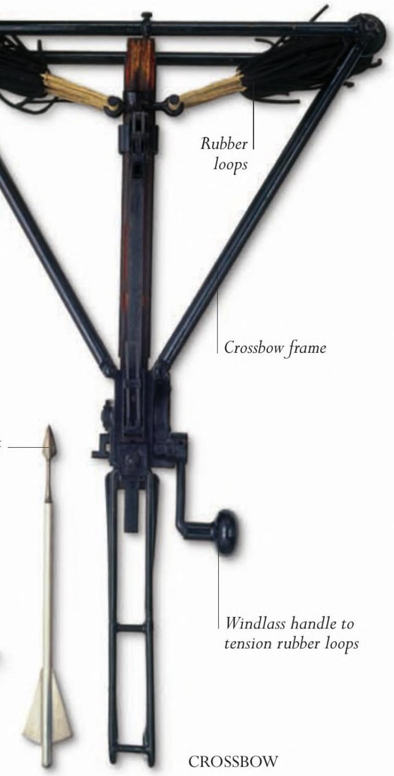
Originally ordered by the US Army Air Corps as a survival aid for downed aircrew, this fearsome-looking weapon became popular with US troops fighting in the Pacific Theatre of Operations – the area of operations of US forces during the Pacific War.


T-shape fits in palm

▲ "MIDDLE EAST" PATTERN KNUCKLE-DUSTER KNIFE

Date	c.1943
Origin	UK
Weight	450g (15¾oz)
Length	30cm (11¾in)

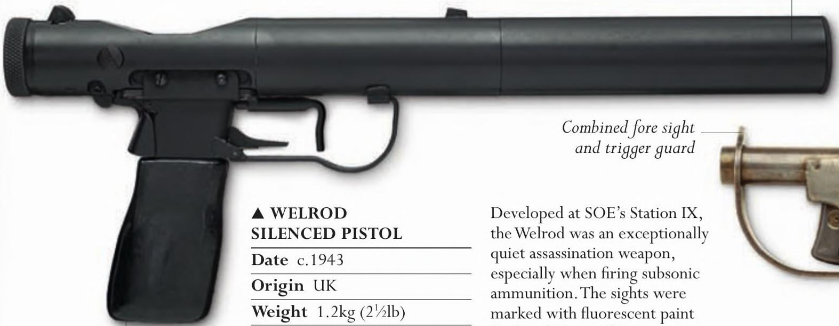
Cast from a single piece of brass, this knife had four protruding studs on the hilt for punching. The steel blade had a single cutting edge that swept upwards to a point, making this knife suitable for stabbing upwards.


Rubber loops
Crossbow frame
Metal bolt
Windlass handle to tension rubber loops
BOLT
CROSSBOW

▲ "BIG JOE" CROSSBOW AND BOLT

Date	c.1943
Origin	US
Weight	4kg (8¾lb)
Length	66cm (26in)

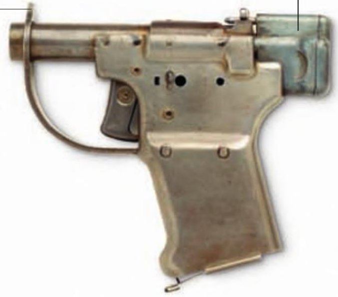
This OSS crossbow was powered by rubber loops that were tensioned by a windlass handle before firing. The front frame and shoulder stock could be folded for ease of transport.


Barrel containing baffles and wipes to suppress sound
Pistol grip containing six-round magazine

▲ WELROD SILENCED PISTOL

Date	c.1943
Origin	UK
Weight	1.2kg (2½lb)
Barrel	30.5cm (12in)
Calibre	9mm

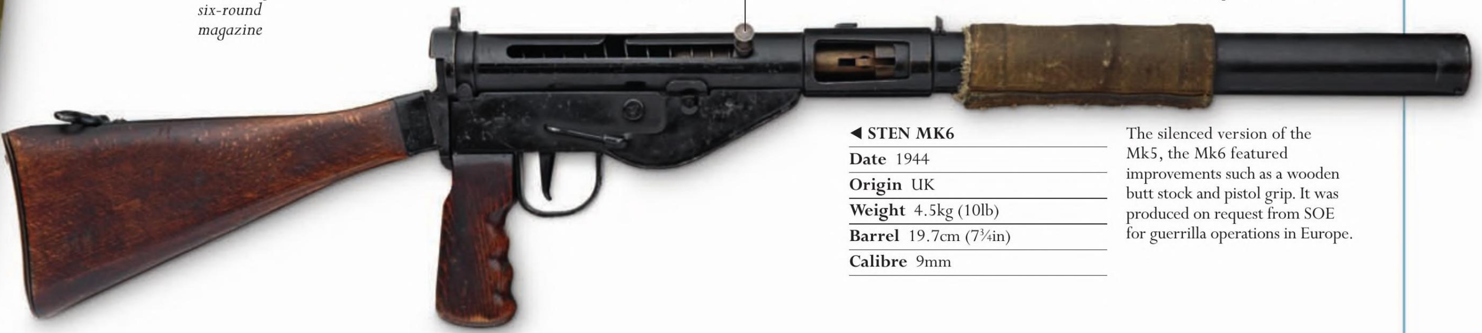
Developed at SOE's Station IX, the Welrod was an exceptionally quiet assassination weapon, especially when firing subsonic ammunition. The sights were marked with fluorescent paint for low-light conditions.


Combined fore sight and trigger guard
Breech block

◀ FP-45 LIBERATOR PISTOL

Date	1942
Origin	US
Weight	450g (15¾oz)
Barrel	10cm (4in)
Calibre	.45in

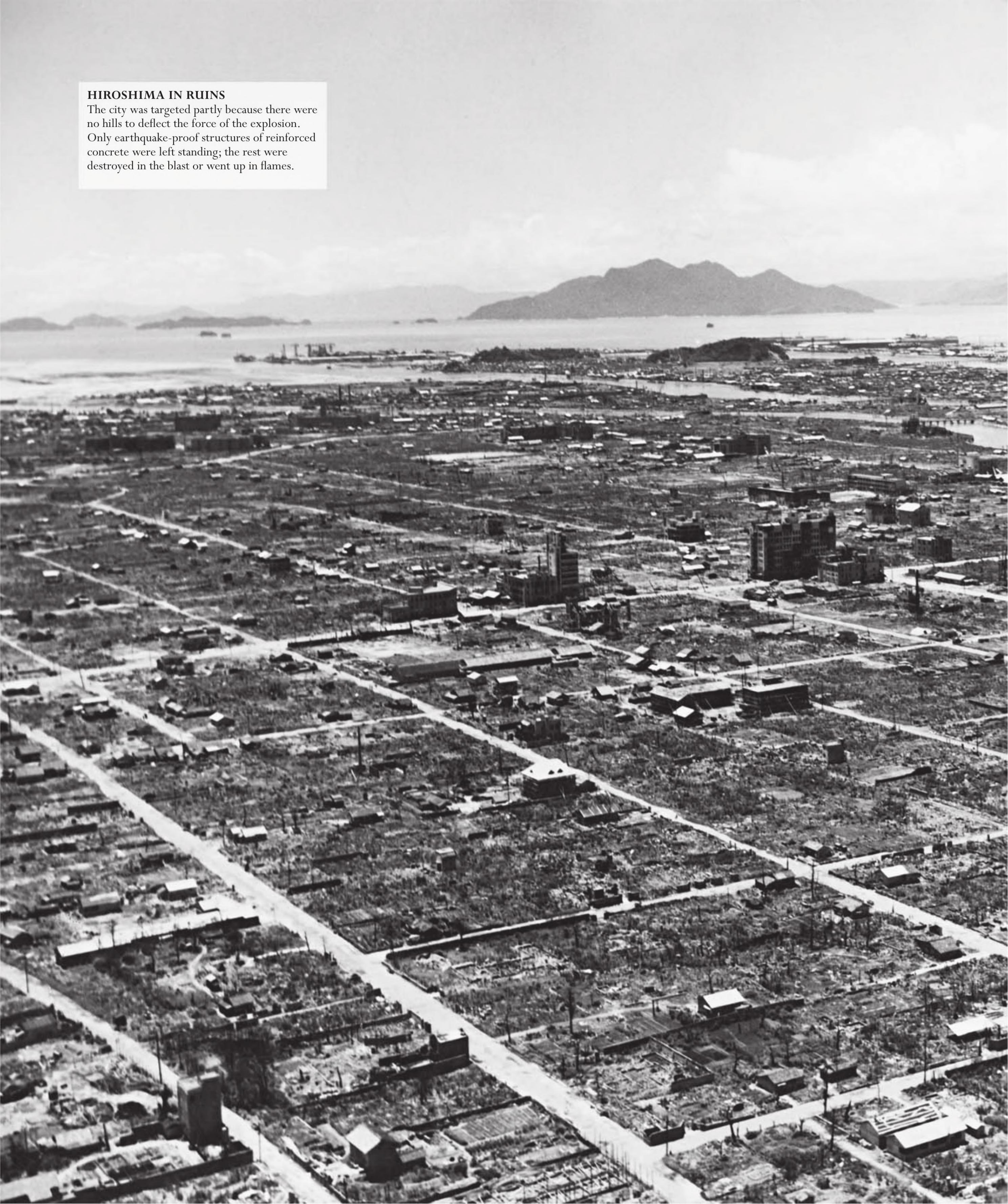
Designed by OSS as a simple and very cheap gun, the Liberator was intended to be paradropped to resistance groups. It had ten rounds of ammunition and was delivered with illustrated strip instructions for use.


Cocking handle

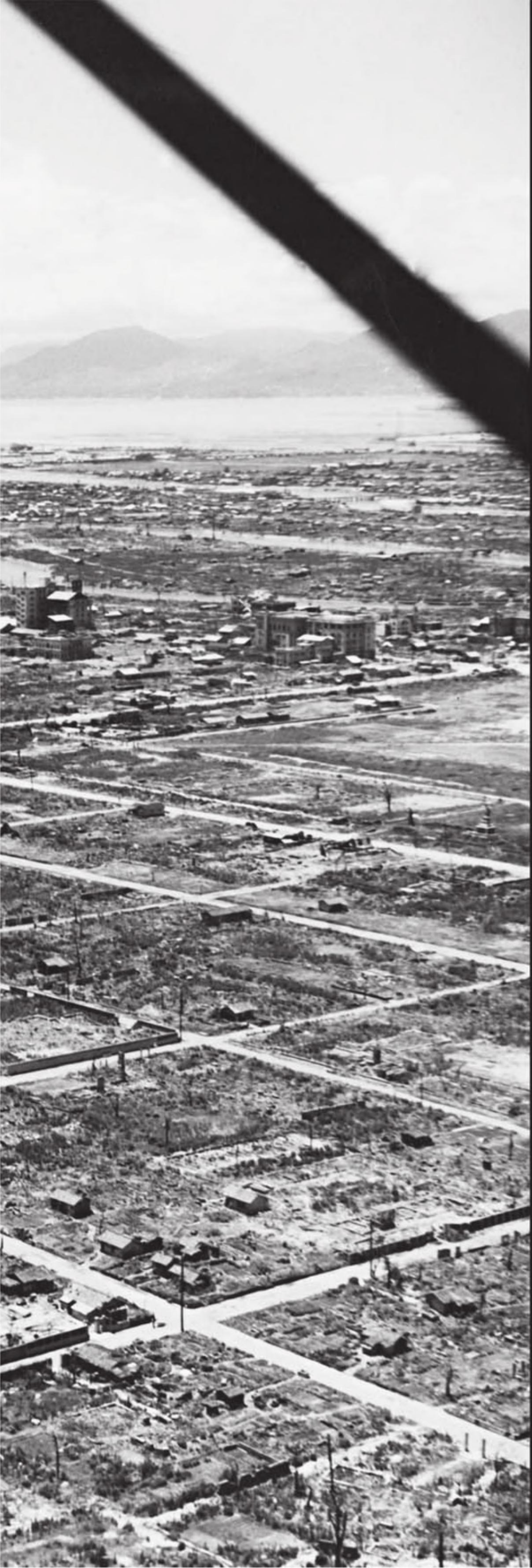
◀ STEN MK6

Date	1944
Origin	UK
Weight	4.5kg (10lb)
Barrel	19.7cm (7¾in)
Calibre	9mm

The silenced version of the Mk5, the Mk6 featured improvements such as a wooden butt stock and pistol grip. It was produced on request from SOE for guerrilla operations in Europe.



HIROSHIMA IN RUINS
The city was targeted partly because there were no hills to deflect the force of the explosion. Only earthquake-proof structures of reinforced concrete were left standing; the rest were destroyed in the blast or went up in flames.



NUCLEAR WARFARE

THE BOMBING OF HIROSHIMA

When US aircraft dropped atom bombs on the Japanese cities of Hiroshima and Nagasaki in August 1945 in a bid to end World War II, it opened a new perilous chapter in the history of warfare. For the first time, weapons had been created that were so destructive that their use had to be avoided at all costs.

The first test of a nuclear device took place at Alamogordo in the New Mexican desert on 16 July 1945. The explosion was equivalent to over 18,000 tonnes of TNT and generated temperatures three times hotter than the core of the Sun. The detonation was the culmination of the top secret Manhattan Project that had been initiated in December 1941 and headed by General Leslie Groves.

The objective of the project was to produce an atom bomb and deliver it on an enemy target, and to this end Groves had not only directed teams of scientists and engineers, but also set up a special flying group to drop the bomb. Group 509 of the US Army Air Force, commanded by Colonel Paul Tibbets, was equipped with the Boeing B-29 Superfortress, America's latest bomber aircraft, which had the range to strike Japanese cities from US-held Pacific island bases.

In late July and early August, components for a uranium-based atomic bomb, codenamed "Little Boy", and several plutonium-based bombs, codenamed "Fat Man", were delivered to the island of Tinian in the Marianas, where Colonel Tibbets' B-29s were based. The intention was to drop the bombs on selected Japanese cities as soon as the components had been assembled and when weather conditions permitted.

On 26 July, after the Potsdam conference attended by America, Britain, and the Soviet Union, the US and its allies called on Japan to surrender or face "prompt and utter destruction". When this call was rejected by Japan two days later, preparations for the world's first nuclear strike went ahead.

Hiroshima had been chosen as the first target as it was arguably of military significance, with a barracks and port, and was also largely undamaged, unlike most Japanese cities already devastated by conventional bombing. A large and flat urban area with a population of 300,000, Hiroshima would demonstrate the maximum effect of the bomb.

Colonel Tibbets chose to lead the operation in person. He piloted the B-29 designated to carry the "Little Boy" bomb and had his mother's maiden name, *Enola Gay*, written on the aircraft's side.

The *Enola Gay* was escorted by two other B-29s and arrived over Hiroshima at 8:15am on 6 August after an uneventful flight from Tinian. The aircraft released the bomb from an altitude of 30,000 feet, and it detonated in the air a minute later over the centre of the city.

TOTAL DESTRUCTION

The destruction surpassed all expectations: almost every building was destroyed over an area of 12 square km (7.5 miles) and estimates of the death toll range from 80,000 to 140,000. Of this number, those not killed immediately by the effect of the heat flash and blast died of radiation sickness over the following months.

Three days later the "Fat Man" plutonium bomb was dropped on another city, Nagasaki. It killed an estimated 35,000 to 80,000 people – a lower figure because hills had restricted the bomb's effectiveness. Japan surrendered on 15 August, heralding the end of World War II. No nuclear device has been used in warfare since.

1945–PRESENT

THE NUCLEAR AGE

3

INTRODUCTION

After World War II, developments in military technology were driven by the Cold War confrontation between the two "superpowers" – the United States and the Soviet Union. At the same time, guerrilla warfare and terrorism have proved enduringly resistant to the world's most advanced military arsenals.

From the late 1940s, a nuclear arms race between the US-led NATO alliance and the Soviet Union created weaponry of awesome destructive power. With long-range bombers replaced by missiles as nuclear delivery systems, by the 1960s the world had entered the era of MAD – Mutually Assured Destruction. Peace between the superpowers was maintained by the certainty of unbearable losses in the event of a nuclear war. At the same time, each side sought to surpass the other in every area of conventional military technology, from the performance of aircraft and submarines, to guidance systems and military satellites. Although World War III never materialized, much of the non-nuclear technology was tried out in the 1960s and 1970s, in wars between Israel and its Arab neighbours, and by the US in Vietnam. However, it was the 1991 Gulf War – the first major post-Cold War conflict – that revealed the true scale of technological progress, showcasing such wonders as smart bombs, stealth aircraft, and cruise missiles.

The post-WWII era has also seen the rise of guerrilla warfare and terrorism. Although they generally lack access to advanced weaponry, guerrillas have benefited from modern infantry weaponry and explosives, while the arms industry has fuelled low-level conflicts across the globe with a ready supply of automatic weapons and ammunition. Despite the fact that technological progress made the need for a mass citizen army outdated by the end of the 20th century, when major powers fought guerrilla forces, they found there was no alternative to putting troops on the ground and sustaining the losses this entailed.

KEY DATES

1945

1947 US Air Force pilot Chuck Yeager flies the Bell X-1 at above the speed of sound

1947–49 The Chinese Civil War results in the establishment of a communist government in Beijing

1949 The Soviet Union tests its first nuclear device; meanwhile, the NATO alliance is formed

1950 Harry S Truman, president of the US, orders development of the hydrogen bomb

1950–53 The Korean War includes the first air combat between jet fighters, and the first extensive use of helicopters

1952 The US carries out its first successful hydrogen bomb test, on Eniwetok atoll, in the Pacific Ocean

1953 The Soviet Union tests the first hydrogen bomb

1954 The French are defeated by Viet Minh guerrillas at Dien Bien Phu

1956 The Sidewinder heat seeking air-to-air missile enters service with the US Air Force

1956–59 Fidel Castro leads a successful guerrilla campaign to take power in Cuba

1959 The first nuclear-armed intercontinental ballistic missiles (ICBMs) are deployed

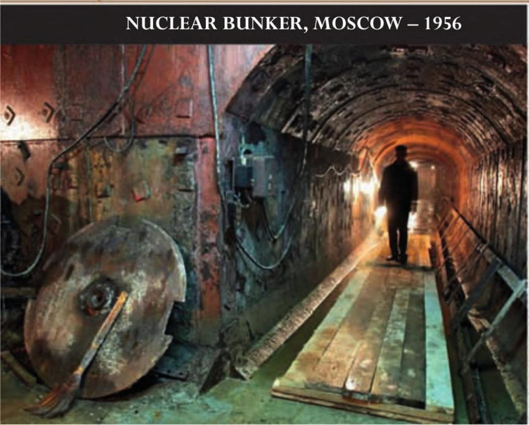
1960s The first night vision devices are used by US troops in Vietnam

1962 The US and the Soviet Union come close to nuclear war in the Cuban Missile Crisis

1964 The Lockheed Blackbird high-altitude reconnaissance aircraft introduces stealth technology

1965 The US commits ground forces to South Vietnam and begins sustained bombing of North Vietnam

1967 AH-1 Cobra attack helicopters and television-guided Walleye bombs are deployed by the US, in Vietnam



NUCLEAR BUNKER, MOSCOW – 1956

OPERATION CEDAR FALLS – 1967

THE APACHE HELICOPTER – 1984

1969 The Soviet Union and the US open Strategic Arms Limitation Talks (SALT)

1970 The hijacking of five airliners by Palestinians begins a wave of international terrorism

1972 The US uses laser-guided bombs to destroy Thanh Bridge in North Vietnam

1973 Arab states use Soviet-supplied surface-to-air (SAM) missiles against Israeli aircraft in the Yom Kippur War

1979 The Soviet Union becomesengaged in a war against US-backed guerrilla forces in Afghanistan

1982 The Falklands War is fought between Britain and Argentina

1983 Tomahawk Cruise missiles enter service

1983–88 Iraq uses mustard gas and other chemical weapons against Iran and Kurds

1989 The fall of the Berlin Wall marks the end of the Cold War

1991 A US-led coalition uses precision-guided munitions against Iraq in Operation Desert Storm

1995 The US Predator Unmanned Aerial Vehicle (UAV) enters service

1999 Making heavy use of aerial bombardment, NATO air forces defeat Serbia in the Kosovo War

2000s US Panoramic Night Vision goggles are developed, which provide 95-degree vision

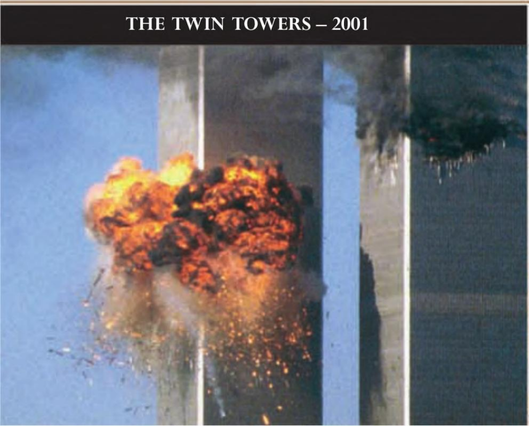
2001 Muslim extremists destroy New York's World Trade Center; the US leads an invasion of Afghanistan

2003 US and British forces invade Iraq

2011 NATO air forces intervene in support of rebels in Libya

PRESENT

THE TWIN TOWERS – 2001



BAGHDAD – 2003

COMBAT IN AFGHANISTAN – 2010

KEY DEVELOPMENT

THE COLD WAR ERA

The end of World War II witnessed the emergence of the Soviet Union and the US as global superpowers, and their ideological hostility was to define international politics for the remainder of the 20th century.

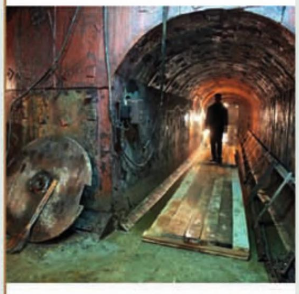
The enmity between these two superpowers was made especially dangerous by the advent of nuclear weapons. The US, the first of the two nations to develop an atomic bomb, used its nuclear supremacy to devastating effect against the Japanese cities of Hiroshima (see pp.378–79) and Nagasaki, in 1945; it lost its lead in 1949, however, when the Soviet Union developed its own atomic bomb. This marked the beginning of an arms race, as the two superpowers developed ever-more powerful weapons and more complex and accurate delivery systems. Scientists invented the hydrogen bomb in the mid-1950s: the blast from the first hydrogen explosion was measured at 10.4 megatons, 450 times more powerful than the bomb dropped on Nagasaki.

Nuclear weapons were initially carried in bomber aircraft, but their vulnerability to air-defence systems soon became apparent. The solution was to supplement the use of bombers with ballistic missiles, which were difficult to intercept. They could be fired from concealed concrete silos and had the range to hit population

KEY **STRUCTURE**

NUCLEAR SHELTER

Away from the cataclysmic centre of a nuclear explosion, people sheltering in deep underground bunkers would have a chance of survival. But the ensuing radioactive fallout would force survivors to remain underground for extended periods, requiring supplies of uncontaminated food, water, and recyclable air.



▲ This nuclear bunker was built in Moscow in 1956, anticipating the fear of an all-out nuclear conflict.

KEY **EVENTS**

1945–1955

- **6 August 1945** A US B-29 aircraft drops an atomic bomb on Hiroshima, marking a new era of nuclear warfare.
- **22 May 1947** President Harry S Truman commits the US to providing military assistance to any nation threatened by Communist aggression. This becomes known as the Truman Doctrine.
- **4 April 1949** The North Atlantic Treaty Organization (NATO) is formed, to provide a military bulwark against the Soviet Union.
- **1 November 1952** The US carries out the first successful test of a hydrogen bomb, on the Eniwetok atoll in the Pacific. The Soviet Union follows suit in 1953.
- **14 May 1955** The Warsaw Pact is agreed, a mutual defence treaty between the Soviet Union and the Communist states of eastern Europe.

▸ **A US NUCLEAR TEST, NEVADA**
US troops watch the mushroom cloud of an atomic explosion while on a field exercise in Nevada, in November 1951. They are just 9.5km (6 miles) from the explosion.

"Mankind must put an **end to war** or war will put an end to **mankind**"

US PRESIDENT JOHN F KENNEDY, 25 SEPTEMBER 1961

centres deep within the territory of any potential enemy. Further refinements included the use of multiple warheads on a single missile, and submarines that were able to fire nuclear weapons while hidden underwater.

The US, exploiting its technical superiority over the Soviet Union, made repeated attempts to construct missile-launched anti-ballistic-missile systems, of which the space-based "Star Wars" defence was the most ambitious. None, however, were successful. Meanwhile, some soldiers were equipped with NBC (Nuclear, Biological, Chemical) suits to help those who survived an initial blast to operate in a radiation-contaminated atmosphere. In an attempt to ensure the continuity of government in the event of nuclear onslaught, extensive underground bunkers were constructed to shelter officials at the onset of war.

NUCLEAR DEADLOCK

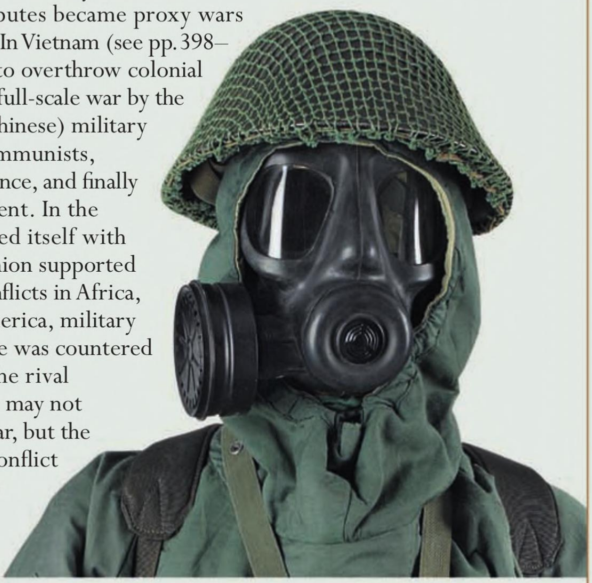
In terms of civilian casualties, however, it was clear that hundreds of millions of people on both sides would be killed if a full nuclear exchange took place, and that life for those who did survive might well be unendurable. Thus, US military policy during the 1960s was driven by the doctrine of Mutually Assured Destruction (MAD), the acronym reflecting the conviction that a nuclear war was effectively unwinnable.

This was the Cold War, when the antagonism between West and East was, paradoxically, moderated by the power of nuclear weapons, each side fearing the consequences of an all-out "hot war" (although during the Cuban missile crisis of 1962, East-West tensions almost let to nuclear war, after US spy aircraft discovered Soviet missile bases in Cuba). This fear did not, however, prevent the leaders of the US and the Soviet Union from aggressively pursuing their interests elsewhere. In what became termed "limited warfare", the armies of the Communist East and capitalist West engaged in military operations to establish dominance over each other. They refrained from direct confrontation, and instead supported other states or groups in secondary conflicts.

In many cases, local disputes became proxy wars between the superpowers. In Vietnam (see pp. 398–99), the people's attempt to overthrow colonial rule was transformed into full-scale war by the provision of Soviet (and Chinese) military aid to the Vietnamese Communists, countered by US aid to France, and finally full US military involvement. In the Middle East, the US aligned itself with Israel, while the Soviet Union supported its Arab opponents. In conflicts in Africa, and Central and South America, military assistance given to one side was countered by similar support from the rival superpower. The Cold War may not have resulted in nuclear war, but the tactic of avoiding direct conflict between the superpowers had the side-effect of exporting warfare all around the globe.

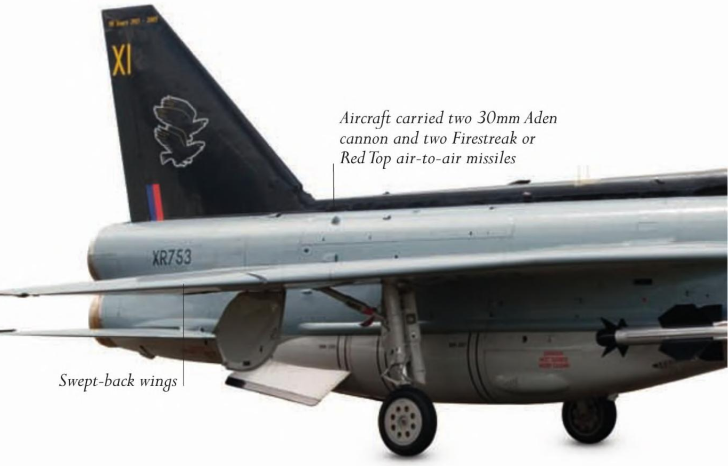
▲ AN UNDERWATER LAUNCH
A Trident ballistic missile is fired from a submarine far out in the ocean. The Trident missile has a range of 7,100km (4,400 miles) and can carry eight independently targeted nuclear warheads.

▼ AN NBC SUIT
The Nuclear, Biological, Chemical (NBC) suit provided basic protection against radiological and other hazards. It could be worn for several days before needing to be replaced.



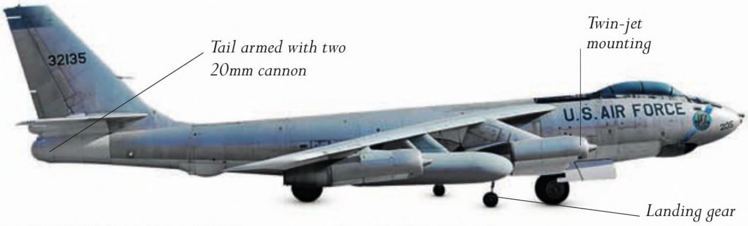
NUCLEAR BOMBERS AND INTERCEPTORS

For twenty years after the attacks on Hiroshima (see pp.378–79) and Nagasaki in 1945, the long-range strategic bomber – which had to be fast and capable of carrying a heavy payload – remained a vital element in every nuclear power's arsenal. A new type of fighter aircraft was produced to counter this threat – the exceptionally fast "interceptor", whose role was to shoot down bombers before they could do any significant damage. By the mid-1960s, however, the development of Intercontinental Ballistic Missiles (ICBMs), such as the submarine-launched Polaris missile, rendered the strategic bomber obsolete; the role of the interceptor was reduced accordingly.



Aircraft carried two 30mm Aden cannon and two Firestreak or Red Top air-to-air missiles

Swept-back wings



Tail armed with two 20mm cannon

Twin-jet mounting

Landing gear

▲ BOEING B-47 STRATOJET

Date 1950 **Origin** US

Wingspan 35.4m (116¼ft)

Length 32.6m (106¾ft)

Top speed 980kph (606mph)

Engine Six 3,266kg (7,185lb) General Electric J47-GE-25 turbojets

One of the first jet bombers to serve with the US Strategic Air Command, the B47 featured a swept-back wing and a substantial internal bomb load.

▼ TUPOLEV TU-95 "BEAR"

Date 1955 **Origin** Soviet Union

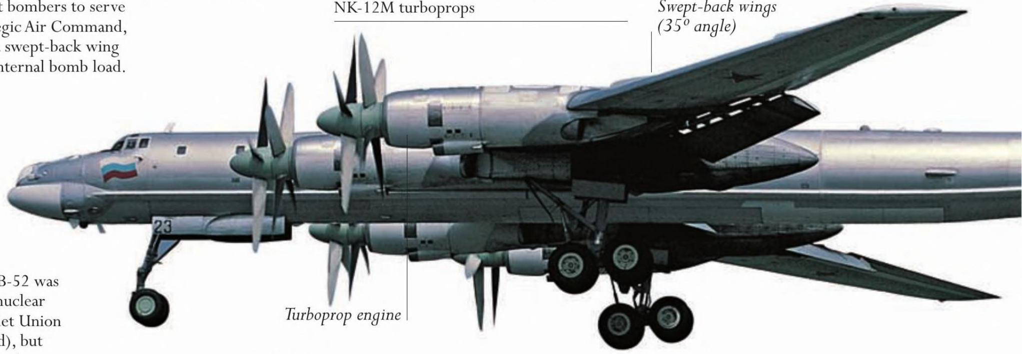
Wingspan 50.1m (164½ft)

Length 46.2m (151½ft)

Top speed 905kph (562mph)

Engine Four 15,000 Kuznetsov NK-12M turboprops

Although equipped with turboprop engines, the Tu-95 demonstrated high performance characteristics that included an exceptional range (with bomb load) of 15,000km (9,300 miles) without refuelling.



Swept-back wings (35° angle)

Turboprop engine

▼ BOEING B-52 STRATOFORTRESS

Date 1955 **Origin** US

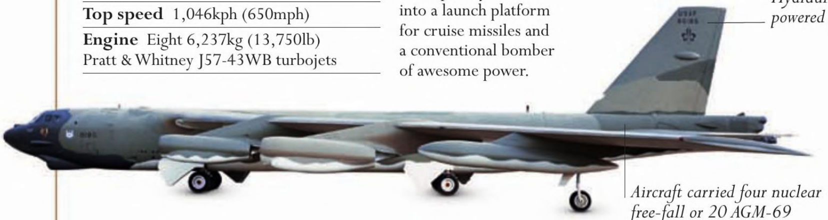
Wingspan 56.4m (185ft)

Length 50.2m (161ft)

Top speed 1,046kph (650mph)

Engine Eight 6,237kg (13,750lb) Pratt & Whitney J57-43WB turbojets

The long-serving B-52 was designed to drop nuclear bombs on the Soviet Union (which it never did), but subsequently evolved into a launch platform for cruise missiles and a conventional bomber of awesome power.



Hydraulically powered rudder

Aircraft carried four nuclear free-fall or 20 AGM-69 SRAM missiles, or up to 27,200kg (60,000lb) of conventional bombs

▼ AVRO 698 VULCAN B2

Date 1956 **Origin** UK

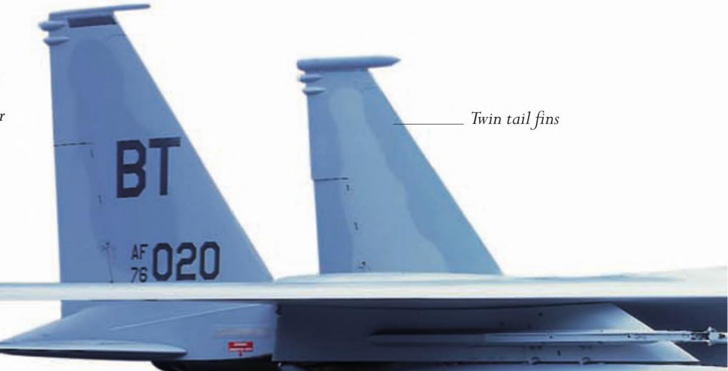
Wingspan 33.9m (111¼ft)

Length 30.5m (100ft)

Top speed 1,029kph (640mph)

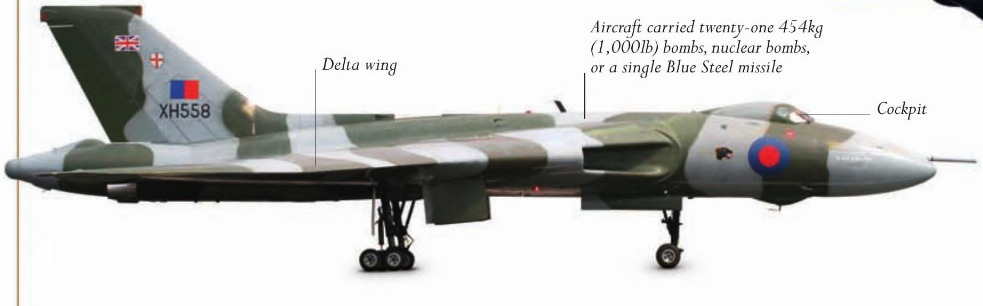
Engine Four 9,992kg (22,000lb) Bristol Siddeley Olympus turbojets

During the late 1950s, the British nuclear deterrent was spearheaded Vulcan B2. It had a distinctive delta wing that helped ensure good load-carrying capabilities and a high subsonic speed.



Twin tail fins

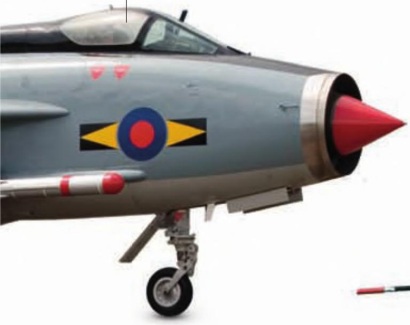
Underwing fuel tank



Delta wing

Aircraft carried twenty-one 454kg (1,000lb) bombs, nuclear bombs, or a single Blue Steel missile

Cockpit



Single-seat cockpit

◀ ENGLISH ELECTRIC LIGHTNING F.1A

Date 1960 **Origin** UK

Wingspan 10.6m (34¾ft)

Length 15.2m (50ft)

Top speed 2,230kph (1,386mph) or Mach 2.1

Engine Two 71.17kN (16,000lb) Rolls Royce Avon 301R turbojets

The Lightning was the first British aircraft to exceed Mach 2 (twice the speed of sound) in level flight. This, combined with its excellent rate of climb, made it Britain's main air-defence fighter.

▼ DASSAULT MIRAGE III C

Date 1961 **Origin** France

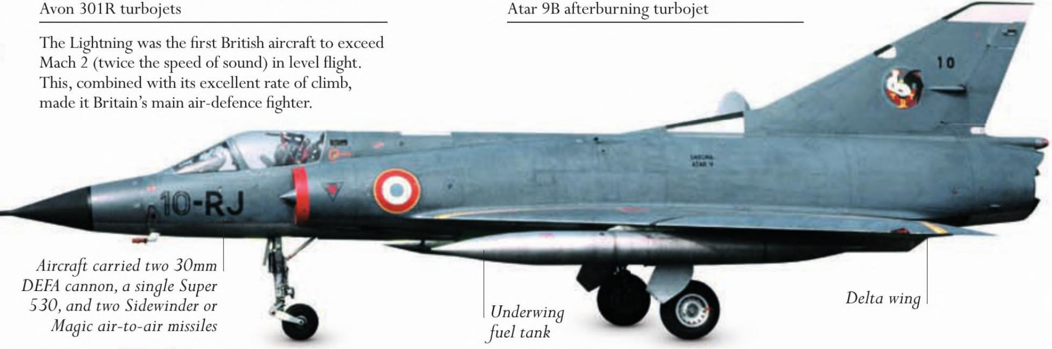
Wingspan 8.2m (27ft)

Length 15.5m (50¾ft)

Top speed 2,350kph (1,460mph)

Engine 6,000kg (13,225lb) SNECMA Atar 9B afterburning turbojet

The delta-winged Mirage III series has been exported to 21 countries, including Israel, which used the aircraft with great success during the Six-Day War of 1967.



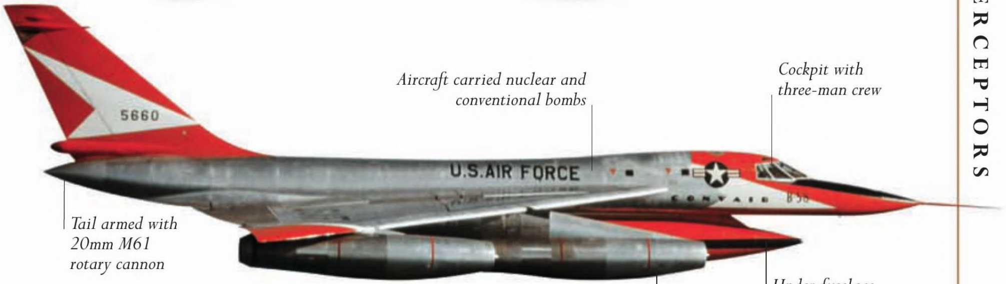
Aircraft carried two 30mm DEFA cannon, a single Super 530, and two Sidewinder or Magic air-to-air missiles

Underwing fuel tank

Delta wing

Armed with seven 23mm NR cannon in three turrets and nose, a 20,000kg (44,092lb) bomb load, or a single AS-3 stand-off missile

23mm autocannon in tail turret



Aircraft carried nuclear and conventional bombs

Cockpit with three-man crew

Tail armed with 20mm M61 rotary cannon

Under-fuselage fuel pod

Afterburning turbojet

▲ CONVAIR B-58 HUSTLER

Date 1961 **Origin** US

Wingspan 17.3m (56¾ft)

Length 29.5m (96¾ft)

Top speed 2,122kph (1,319mph) or Mach 2

Engine Four 6,815kg (15,020lb) General Electric J79-GE-5A/B/C afterburning turbojets

This highly ambitious supersonic nuclear bomber utilized many of the latest advances in aviation technology. Although difficult to fly, it was capable of a high maximum speed.

▼ MCDONNELL DOUGLAS F-15C EAGLE

Date 1976 **Origin** US

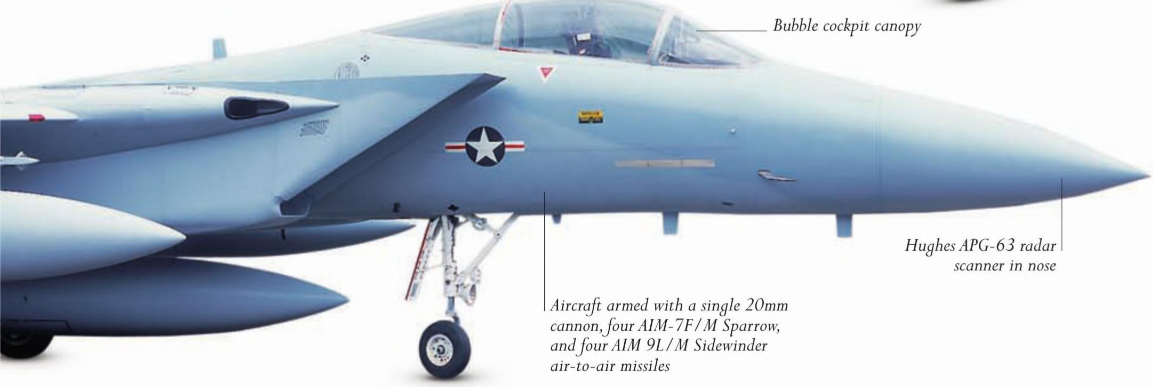
Wingspan 13m (42¾ft)

Length 19.4m (63¾ft)

Top speed 2,660kph (1,650mph)

Engine Two 17,450lb (77.62kN) Pratt & Whitney F100-100 augmented turbofans

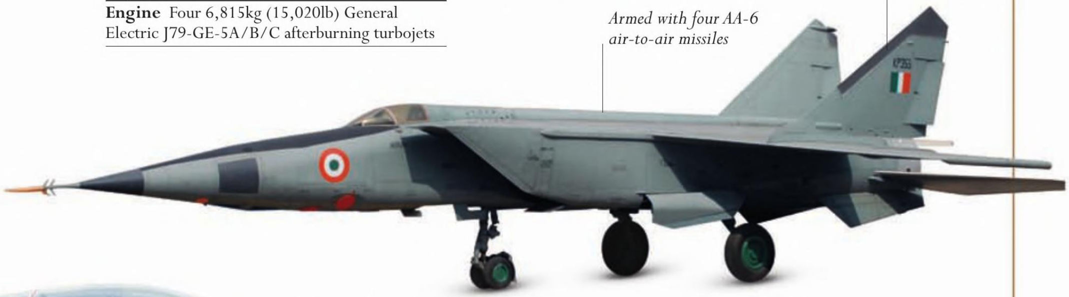
Built as a response to the MiG-25, the F-15C Eagle emerged as one of the world's foremost fighter and strike aircraft, utilizing advanced avionics with immense power and performance.



Bubble cockpit canopy

Hughes APG-63 radar scanner in nose

Aircraft armed with a single 20mm cannon, four AIM-7F/M Sparrow, and four AIM 9L/M Sidewinder air-to-air missiles



Twin fins

Armed with four AA-6 air-to-air missiles

▲ MIKOYAN-GUREVICH MIG-25 "FOXBAT"

Date 1970 **Origin** Soviet Union

Wingspan 14m (46ft)

Length 19.8m (64¼ft)

Top Speed 3,000kph (1,868mph) or Mach 3.2

Engine Two 11,200kg (24,651lb) Tumansky R-15B-300 turbojets

Built for speed and high altitudes, the MiG-25 caused consternation in the West. Capable of exceeding Mach 3 (three times the speed of sound), it remains the world's fastest combat aircraft.

NUCLEAR ATTACK SUBMARINE

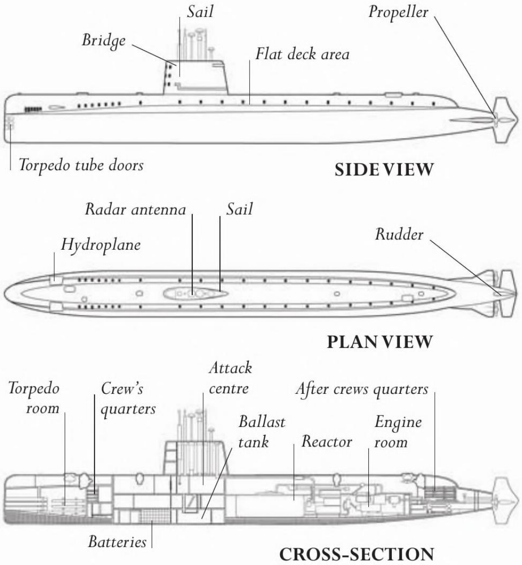
USS NAUTILUS

When the *Nautilus* entered service in 1954, it was the world's first nuclear-powered submarine. Its advent in the early part of the Cold War (see pp.384–85) marked a revolutionary step in naval warfare.

Three reactors enabled the *Nautilus* to travel for long periods without having to surface or refuel, unlike conventional submarines. In 1955, the ship set a new record for a submerged voyage, covering 2,222km (1,381 miles) in 90 hours. Three years later it became the first submarine to travel under the ice cap to the North Pole.

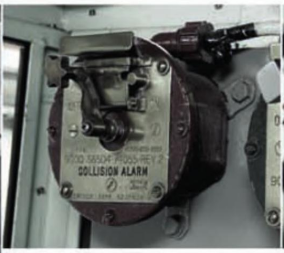
On the *Nautilus*'s upper deck was the attack centre – the heart of the ship's role as a warship. Forward of that were captain's and officers' quarters. The lower deck housed the control room, from where the ship was steered when under water, and the crew's mess and galley. The engines and reactors were near the stern.

The *Nautilus* was not especially fast under water and carried only conventional torpedoes. Apart from the reactors, its major innovations were dispensing with a deck gun, providing a bunk for each crew member, and (on its 1958 sub-Arctic trip) an inertial navigation system. By 1959, the *Nautilus* was being superseded by submarines that, through improved hull design and the use of new materials, could travel faster and reach greater depths than before. Nuclear submarines would soon dominate naval warfare, either as torpedo-carrying attack submarines or as nuclear missile carriers. Retired in 1980, the *Nautilus* is now a museum.



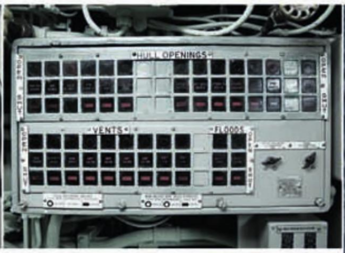
▲ **USS *NAUTILUS***
Displacing 3,533 tons (4,092 tons submerged), the *Nautilus* was 98.6m (323½ft) long and carried a crew of 116. It had a top speed of 23 knots and could dive to a maximum depth of 213m (700ft).

OPERATING SYSTEMS

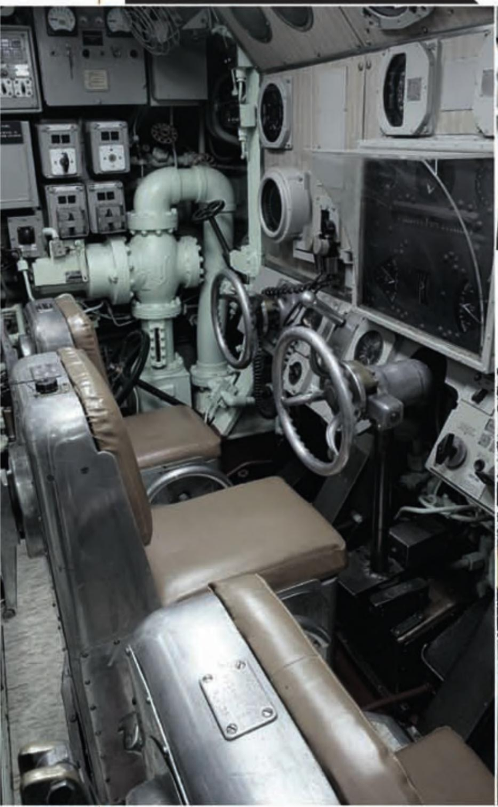


▲ **ALARMS**
Alerts were sounded before the craft began to dive or if there was danger of a collision.

▲ **WATER LEVELS**
Dials indicated the amount of water contained in the ship's ballast tanks.

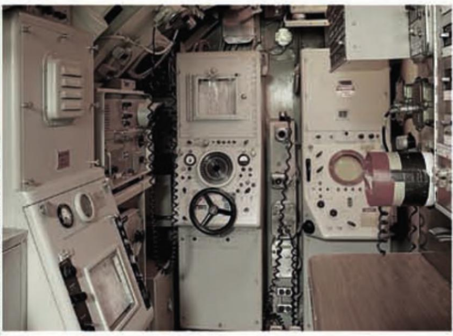


▲ **DISPLAY PANEL**
Prior to diving, this panel was checked to determine the status of the craft's numerous hatches and vents.



▲ **CONTROL ROOM**
Two planesmen operated the hydroplanes to adjust the ship's angle and depth. To their right, the helmsman operated the rudder.

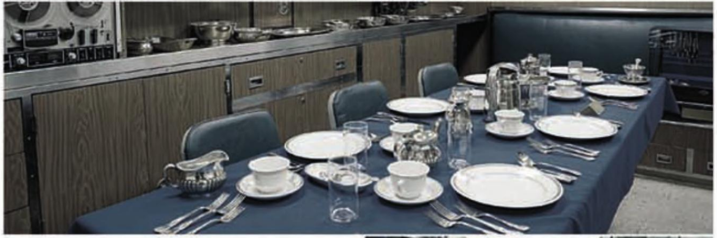
▲ **ELECTRONIC COUNTER-MEASURES**
These devices detected signals from other vessels and helped foil attempts to track the ship from its own transmissions.



▲ **SONAR ROOM**
Sonar equipment and displays were used to locate ships and other submarines, follow target objects, and avoid underwater collisions.

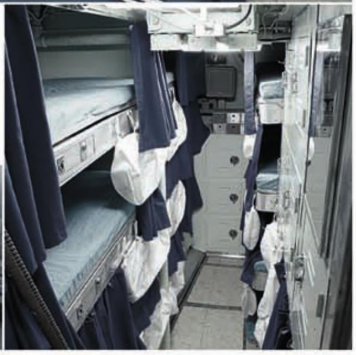
► **SUBMARINE SAIL**
When travelling on the surface, the *Nautilus* was steered from the bridge, located at the top of the submarine's "sail" (conning tower).

LIFE ON BOARD



▲ WARDROOM The captain and officers dined and relaxed in the wardroom. For the first time on a submarine there was an attempt at decoration, with pipes and ducts covered by panels.

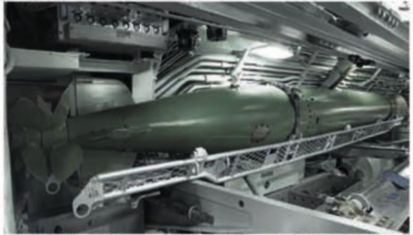
▲ GALLEY The crew's meals were made in a stainless-steel galley. There were also ice cream and drinks machines.

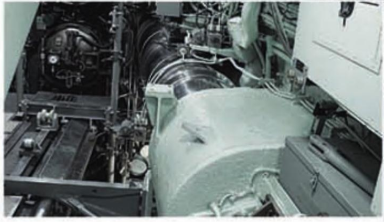


▲ CREW'S QUARTERS Each crew member had his own bed – an improvement on previous submarines, which used a shift system for bunks.

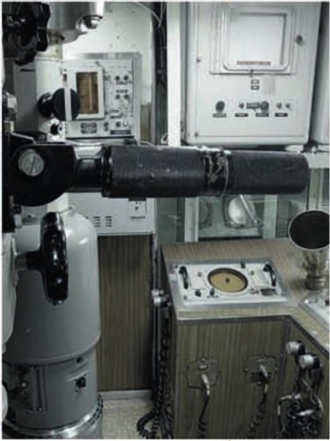
BATTLE STATIONS

► TORPEDO The only armaments on the *Nautilus* were torpedoes. Some were kept in the tubes, ready for firing. Others were stored on racks in the torpedo bay.





▲ TORPEDO BAY In the bow were 24 Mk 14 torpedoes, and the launching mechanisms. The door of one of the six torpedo tubes can be seen on the left.



► ATTACK CENTRE Combat instructions were given from this area, which housed two periscopes, torpedo-firing controls, and navigational equipment.

KEY DEVELOPMENT

GUERRILLAS AND TERRORISTS

Guerrilla warfare has existed for centuries, but it was the Chinese Communist leader Mao Zedong who, during the Chinese civil war, gave it its modern form. Mao gathered support within rural communities, and built a grass-roots force that he used to wage a campaign of armed harrassment against the Chinese government. Mao later expanded his guerrilla forces to conduct conventional military operations.

Guerrilla war, inspired by leaders such as Mao and, later, Cuban revolutionary Fidel Castro, gained enormous influence in the postwar period, when nationalists in Asia and Africa were fighting for independence from European colonial rule – notably the Algerian nationalists against the French in Algiers. However, the emergence of the Cold War (see pp.384–85) complicated matters, as it tended to polarize all such conflicts into a broader struggle of East versus West.

CONFLICT IN VIETNAM

This polarization was epitomized by events during the war in Vietnam, which saw the development of a new model of guerilla warfare. Adopting Mao's strategy as an initial template, a Vietnamese Nationalist–Communist coalition rose up against the French administration in 1945. Using classic guerrilla hit-and-run tactics, their lightly armed, highly mobile forces wore down the French army, and then, in 1954, defeated it in a pitched battle at Dien Bien Phu. The subsequent peace settlement was followed by elections, which the US sabotaged for fear that North Vietnamese Communist leader Ho Chi Minh would win. This, in turn, was the trigger for hostilities between the Communist north and the US-backed south.

At first, it seemed inevitable that the better-equipped US would crush the insurgency with superior weapons and air power. The Vietnamese Communists received extensive military assistance from China and the Soviet Union; although this consisted mainly of World War II-era rifles and machine-guns to begin with, the Vietnamese were also tenacious and focused on their objectives, while the Americans lacked a coherent counterinsurgency strategy. Years of bitter guerrilla warfare failed to secure victory for the US; disillusioned and exhausted, it withdrew its forces in 1972 – a prelude to a North Vietnamese takeover of the country.

With the demise of colonial empires by the mid-1970s, guerrilla conflicts became more diverse. The US sponsored its own insurgent

KEY **FIGURE**

MAO ZEDONG

1893–1976

The son of a farmer, Mao went to university in Beijing, where he studied the works of Marx, and co-founded the Chinese Communist Party (CCP) in 1921. In contrast to the conventional Communist reliance on urban workers, Mao mobilized the rural peasants, who became the bedrock of his military revolution.

▲ After defeating the Nationalists in 1949, Mao dominated Chinese political life until his death in 1976.

◄ **GUERRILLA WEAPONS**
Iraqi insurgents often use RPGs (an abbreviation of the Russian for "manually operated anti-tank grenade launcher"), and improvised explosive devices (IEDs), which are cheap but effective against occupying forces' vehicles. Other tactics include sniping, mortar strikes, and suicide bombings.

◂ AMERICAN AIRBORNE ASSETS Troops from the US First Cavalry Division leap from a UH-1 Iroquois helicopter (a "slick" Huey), in Vietnam. Although the Americans exploited their aerial advantage with skill, they were unable to prevail.

"Politics is **war without bloodshed**, while **war is politics with bloodshed**"

MAO ZEDONG, *ON PROTRACTED WAR*, MAY 1938

campaigns – the Contras, against the left-wing Nicaraguan government, and the Mujahideen, against the Soviet Union's Red Army in Afghanistan. Towards the end of the 20th century, low-intensity, guerrilla-style warfare had also become endemic in parts of Africa – notably in the failed states of the the Congo basin and the Horn of Africa – as warring bands fought for local supremacy. Guerrilla wars were predominantly rural in origin and character, while terrorism was mainly an urban phenomenon. Typical terrorist tactics such as assassination, extortion, kidnapping, and bombings were used by guerrilla groups – but from the 1960s onwards, terrorism began to develop a character of its own.

If guerrilla insurgencies were violent attempts to gain control of a state, terrorism was an extreme form of protest, often an attempt to publicize a cause, or destabilize a society. Terrorism took many forms, reflecting the differing backgrounds and grievances of its participants. It included middle-class angst against the capitalist state, given violent form by the German Red Army Faction, the spate of plane hijackings in support of the Palestinian cause in the 1970s, and assassinations in Spain by the Basque separatist movement, ETA. However, for the West, the most worrying trend was the emergence of radical Islamist terrorists in the 1990s. Characterized by resentment towards the US and its allies, their attacks on the World Trade Center and the Pentagon in the US, in 2001, ushered in a new era in which the threat of large-scale terrorist attacks on civilian populations is never far from the public consciousness.

KEY **EVENTS**

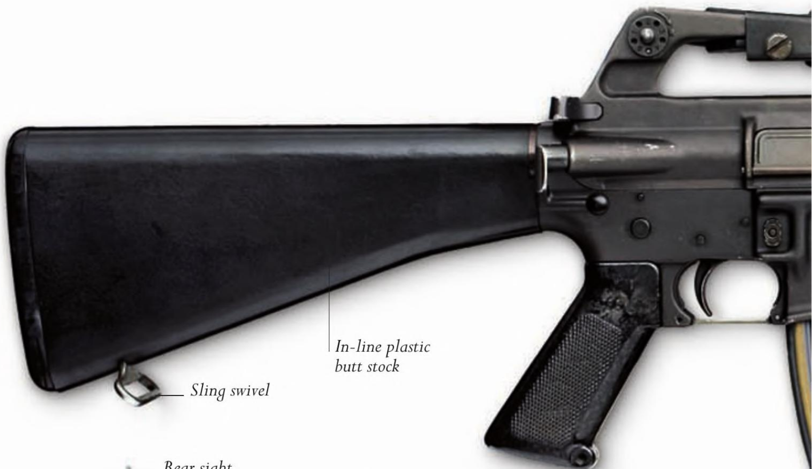
1945–PRESENT

- **1 October 1949** The People's Republic of China is founded, after more than two decades of warfare, under Mao Zedong's leadership.
- **7 May 1954** French forces besieged in Dien Bien Phu, in Vietnam, surrender to the communist Vietminh. The French had hoped that they could defeat the Vietminh in a conventional military operation, but found themselves totally overwhelmed.
- **8 March 1965** US Marines land near Da Nang, as part of an American effort to combat communist insurgency.
- **13 October 1977** A Lufthansa airliner is hijacked by guerrillas in support of the German Red Army Faction. German special forces subsequently storm the aircraft in Mogadishu, Somalia, and release the 86 passengers unharmed.
- **24 December 1979** The Soviet occupation of Afghanistan begins, prompting the US to supply Afghan Mujahideen resistance fighters covertly with money and arms.
- **29 December 1992** A hotel in Aden, used by US troops on their way to Somalia, is bombed. It is al-Qaeda's first attack.
- **11 September 2001** Al-Qaeda (see p.408) launches terror attacks on America.

▾ HECKLER & KOCH MP5 Used by anti-terrorist forces, this submachine-gun is accurate, reliable, and has a relatively low recoil, enabling controlled automatic fire.

ASSAULT RIFLES

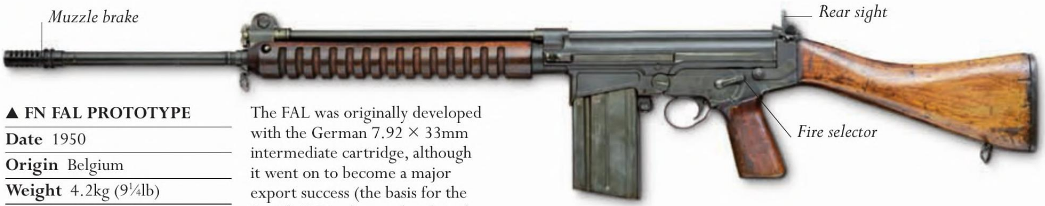
After World War II, there was a demand for infantrymen to be equipped with fully automatic rifles, but the full-powered rifle cartridge was too powerful for accurate automatic fire. The solution lay in the intermediate cartridge that had been pioneered in the German StG44, a development followed by the widespread reduction in calibre sizes that led to the NATO 5.56 × 45mm cartridge replacing the heavier 7.62 × 51mm equivalent. The resulting weapon – the assault rifle – was further adapted to incorporate other new ideas, among them the "bullpup" design in which the trigger group was fitted forward of the magazine, making the rifle more compact.


In-line plastic butt stock
Sling swivel

▲ M16A1 ASSAULT RIFLE

Date	1967
Origin	US
Weight	3.64kg (8lb)
Barrel	50.8cm (20in)
Calibre	5.56 × 45mm

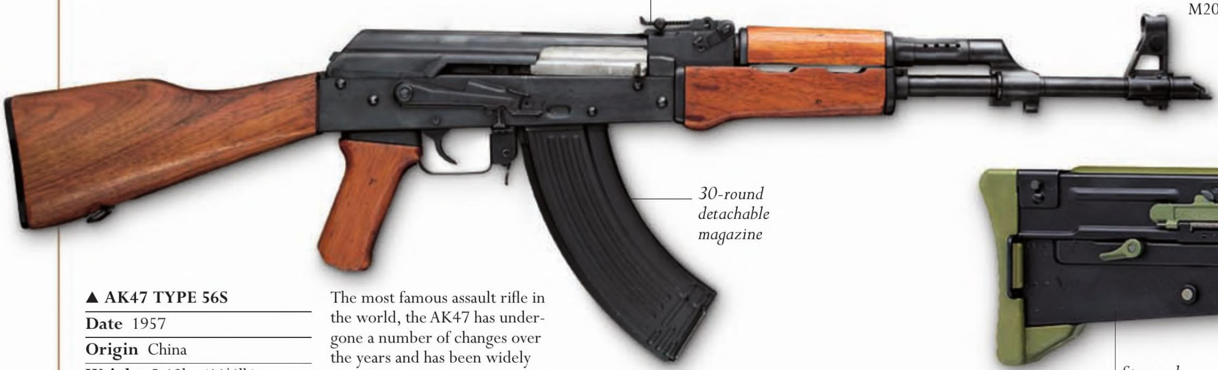
Introduced in the Vietnam War, the M16 series has developed into one of the world's key small arms. This example is fitted with an M203 grenade launcher.


Muzzle brake
Rear sight
Fire selector

▲ FN FAL PROTOTYPE

Date	1950
Origin	Belgium
Weight	4.2kg (9¼lb)
Barrel	60cm (23½in)
Calibre	.280

The FAL was originally developed with the German 7.92 × 33mm intermediate cartridge, although it went on to become a major export success (the basis for the British SLR) when rechambered for the 7.62 × 51mm NATO round.

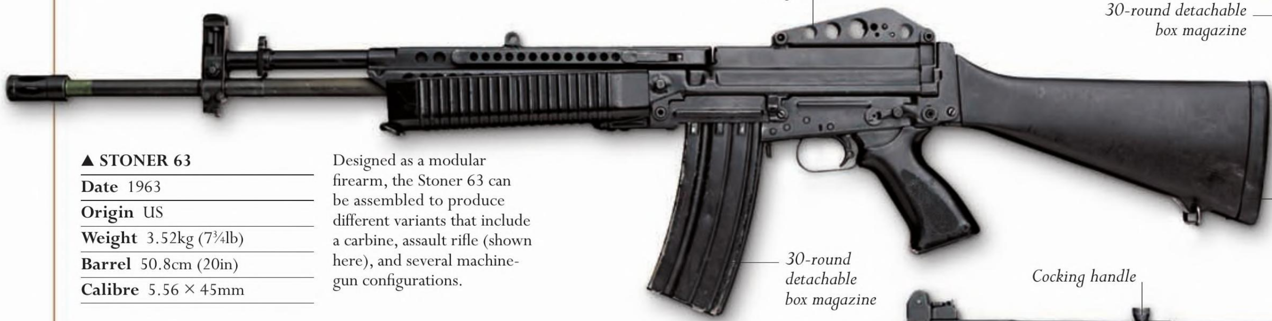

Rear sight
30-round detachable magazine

▲ AK47 TYPE 56S

Date	1957
Origin	China
Weight	5.13kg (11¼lb)
Barrel	41.4cm (16¼in)
Calibre	7.62 × 39mm

The most famous assault rifle in the world, the AK47 has undergone a number of changes over the years and has been widely copied. This Type 56S civilian variant was made in China.

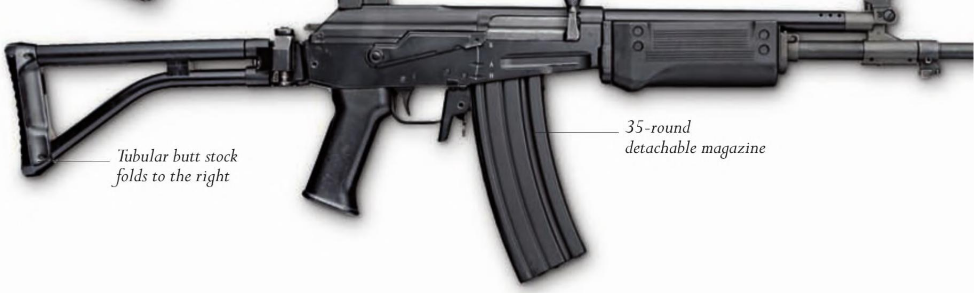
Stamped steel body
30-round detachable box magazine


Shrouded rear sight
Butt stock
30-round detachable box magazine

▲ STONER 63

Date	1963
Origin	US
Weight	3.52kg (7¾lb)
Barrel	50.8cm (20in)
Calibre	5.56 × 45mm

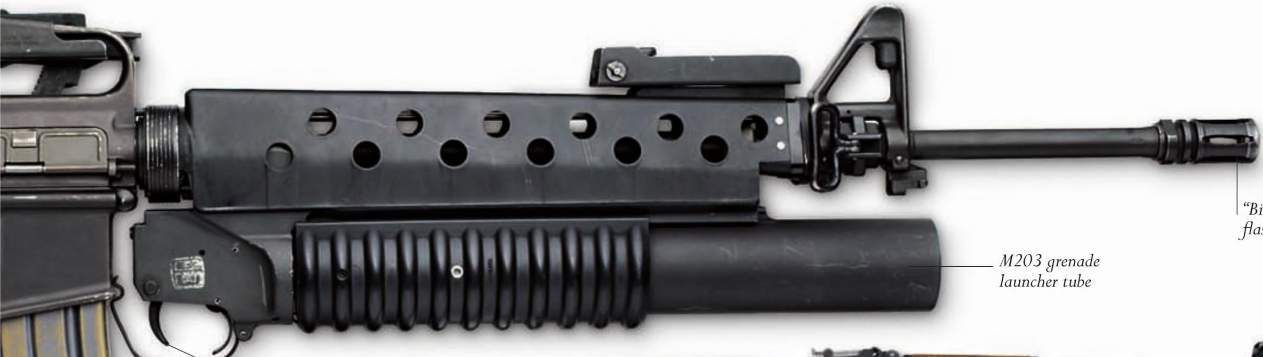
Designed as a modular firearm, the Stoner 63 can be assembled to produce different variants that include a carbine, assault rifle (shown here), and several machine-gun configurations.

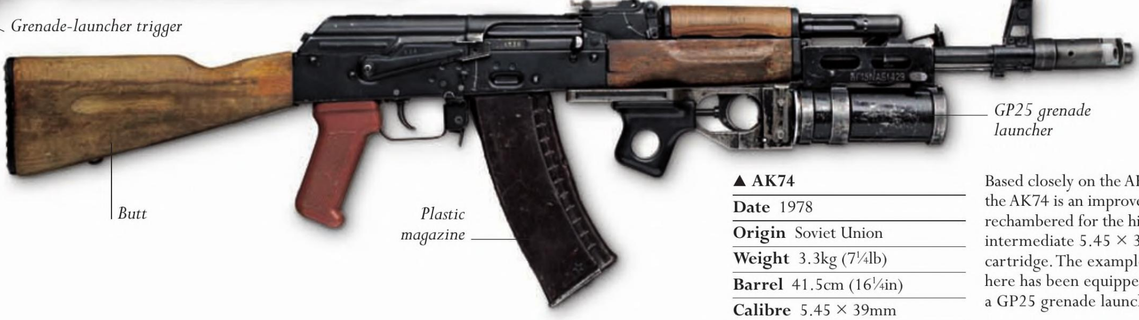

Cocking handle
Tubular butt stock folds to the right
35-round detachable magazine

▶ GALIL

Date	1972
Origin	Israel
Weight	3.95kg (8¾lb)
Barrel	46cm (18in)
Calibre	5.56 × 45mm

The Galil is based on the Finnish Valmet M62, itself derived from the AK47. The Galil comes in a number of variants that include a standard assault rifle, light machine-gun, and sharpshooter rifle.


"Birdcage" flash hider
M203 grenade launcher tube
Grenade-launcher trigger
30-round detachable box magazine


Butt
Plastic magazine
GP25 grenade launcher

▲ AK74

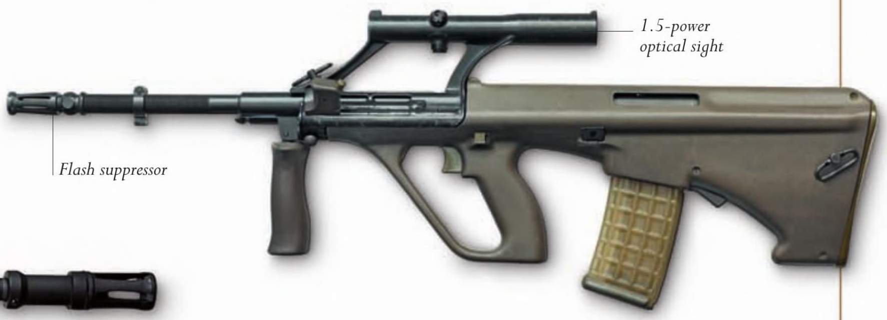
Date	1978
Origin	Soviet Union
Weight	3.3kg (7¼lb)
Barrel	41.5cm (16¼in)
Calibre	5.45 × 39mm

Based closely on the AKM, the AK74 is an improved version rechambered for the high-velocity intermediate 5.45 × 39mm cartridge. The example shown here has been equipped with a GP25 grenade launcher.

▼ L85A1 (SA80)

Date	1985
Origin	UK
Weight	4.98kg (11lb)
Barrel	51.8cm (20½in)
Calibre	5.56 × 45mm

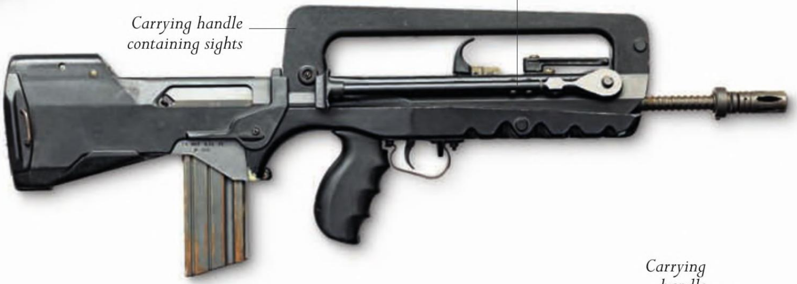
Although dogged by early development problems, the "bullpup"-configured SA80 is now firmly established as the infantry rifle of the British Army, featuring the use of high-impact plastics and optical sights as standard.


1.5-power optical sight
Flash suppressor

▲ STEYR AUG

Date	1978
Origin	Austria
Weight	4.1kg (9lb)
Barrel	50.8cm (20in)
Calibre	5.56 × 45mm

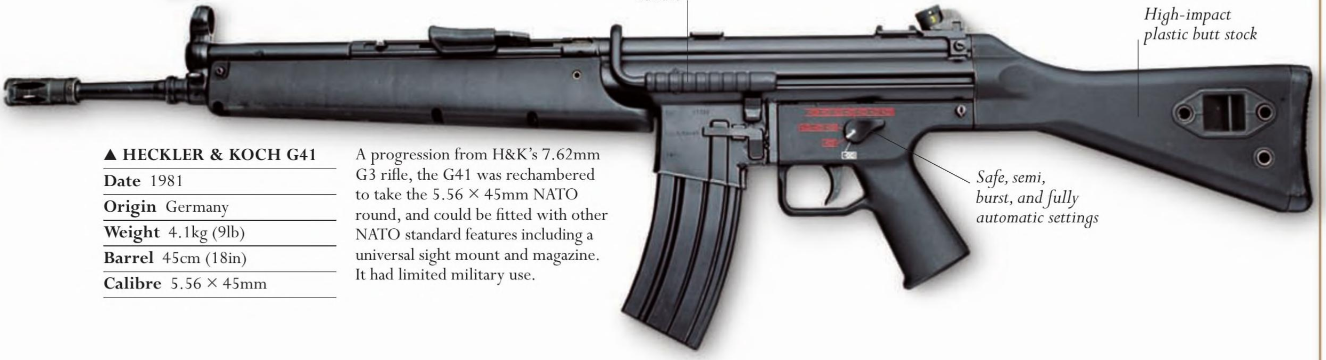
Dating back to the 1970s, the futuristic and highly successful AUG was among the first assault rifles to utilize an integral optical sight, plastic components, and a "bullpup" configuration.


Bipod (folded)
Carrying handle containing sights

◀ FAMAS F1

Date	1978
Origin	France
Weight	3.61kg (8lb)
Barrel	48.8cm (19¼in)
Calibre	5.56 × 45mm

A "bullpup" design, the FAMAS F1 is a very compact weapon, and has been used by the French armed forces since the late 1970s. Like many assault rifles, it makes full use of plastics and metal stampings.


Carrying handle
High-impact plastic butt stock
Safe, semi, burst, and fully automatic settings

▲ HECKLER & KOCH G41

Date	1981
Origin	Germany
Weight	4.1kg (9lb)
Barrel	45cm (18in)
Calibre	5.56 × 45mm

A progression from H&K's 7.62mm G3 rifle, the G41 was rechambered to take the 5.56 × 45mm NATO round, and could be fitted with other NATO standard features including a universal sight mount and magazine. It had limited military use.

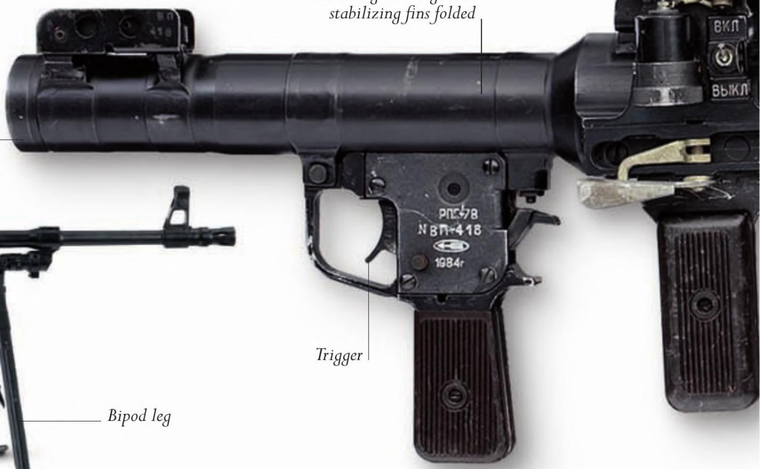
INFANTRY FIREPOWER

Although the modern assault rifle is a highly capable weapon, it lacks sufficient firepower to support infantry fighting on their own, and for this reason portable weapons with greater firepower were developed. The light machine-gun (LMG) is one of the oldest support weapons, capable of providing sustained automatic fire. At the next level is the grenade launcher, followed by the mortar, which provides infantry with miniaturized artillery. Portable anti-tank devices have also proved highly successful – ranging from the light RPG-7V to the just-portable MILAN, which fires missiles that the operator guides by wire to avoid defensive countermeasures.

▼ RPG-7V

Date 1961	
Origin Soviet Union	
Weight 6.3kg (13¾lb)	
Barrel 95cm (37½in)	
Calibre 40mm	
Range 500m (546¾ yards)	
Grenade type AT, AP, HE, thermobarbic	

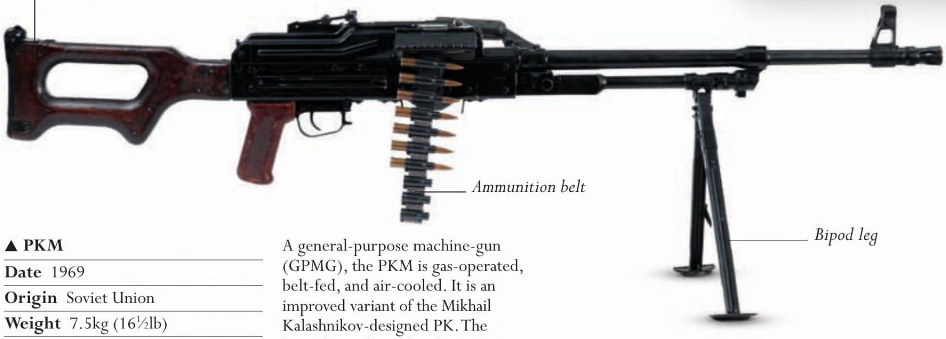
The shoulder-launched RPG-7 fires a projectile with a two-stage launcher/sustainer propellant. As well as optical sights, the weapon has back-up iron sights and a passive infrared sight.



Barrel contains tail of expelling charge, with launching cartridge and stabilizing fins folded

Muzzle, into which projectile is loaded

Trigger



Butt plate contains cleaning kit

Ammunition belt

Bipod leg

▲ PKM

Date 1969	
Origin Soviet Union	
Weight 7.5kg (16½lb)	
Barrel 64.5cm (25¼in)	
Calibre 7.62mm × 54R	

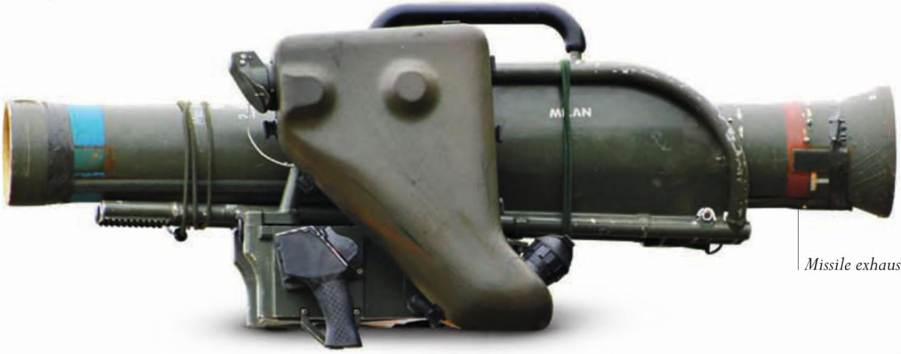
A general-purpose machine-gun (GPMG), the PKM is gas-operated, belt-fed, and air-cooled. It is an improved variant of the Mikhail Kalashnikov-designed PK. The butt plate is hinged and contains a cleaning kit.

Skeleton light-alloy butt stock

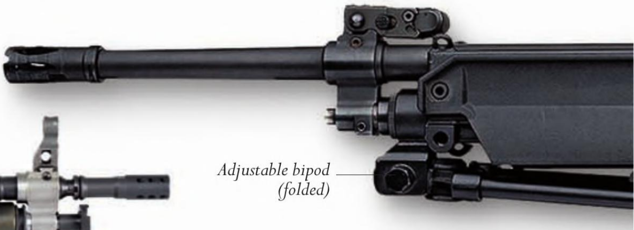
▶ MILAN ANTI-TANK MISSILE

Date 1972	
Origin France, West Germany	
Weight (Loaded) 34kg (75lb)	
Length 1.2m (4ft)	
Calibre 125mm	
Armour penetration 650mm (25½in)	

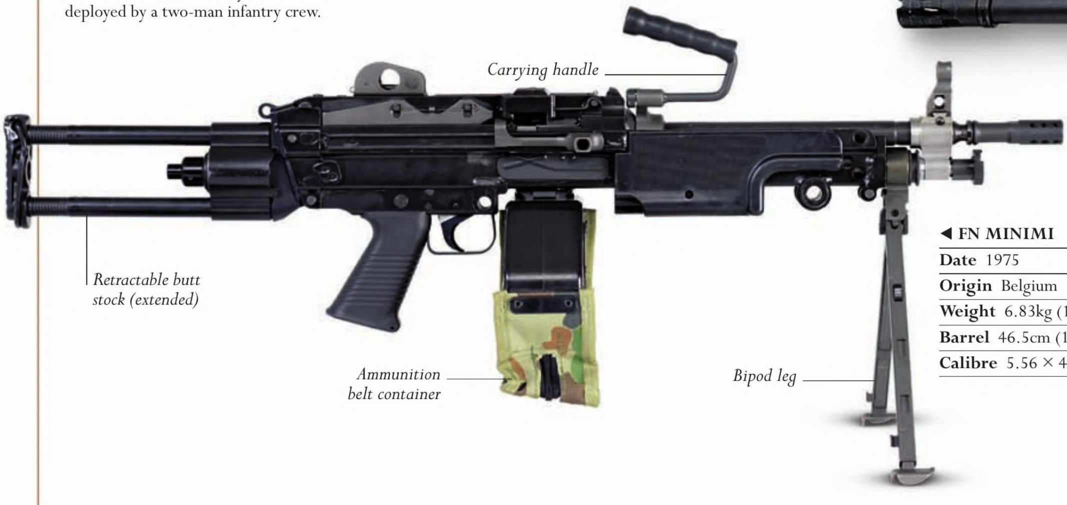
The MILAN is an anti-tank weapon that enables an operator to guide the missile to its target via signals sent along long, thin wires attached to the missile. Although many MILANs are vehicle-mounted, they can be deployed by a two-man infantry crew.



Missile exhaust tube



Adjustable bipod (folded)



Carrying handle

Retractable butt stock (extended)

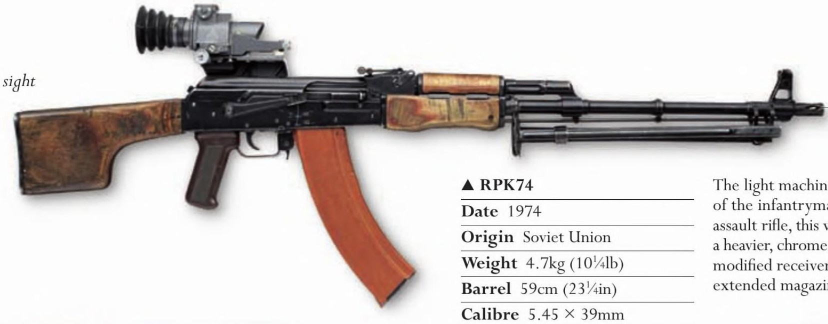
Ammunition belt container

Bipod leg

◀ FN MINIMI

Date 1975	
Origin Belgium	
Weight 6.83kg (15lb)	
Barrel 46.5cm (18¼in)	
Calibre 5.56 × 45mm	

An outstanding gas-operated, air-cooled light machine-gun, the Minimi has been adopted by the British Army and the US Army, amongst others, where it has been designated the M249 Squad Automatic Weapon (SAW).


Muzzle brake

▲ RPK74

Date	1974
Origin	Soviet Union
Weight	4.7kg (10¼lb)
Barrel	59cm (23¼in)
Calibre	5.45 × 39mm

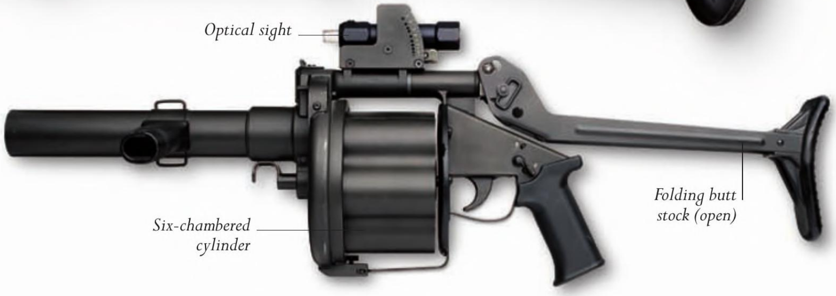
The light machine-gun version of the infantryman's AK74 assault rifle, this weapon features a heavier, chrome-plated barrel, a modified receiver, a bipod, and an extended magazine.

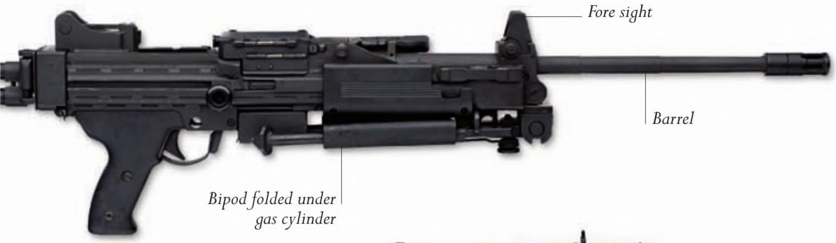
Optical sight
Venturi nozzle to shield blast
Wooden heat shield to protect operator's shoulder

▼ NEGEV

Date	1988
Origin	Israel
Weight	7.2kg (15¾lb)
Barrel	46cm (18in)
Calibre	5.56mm

Israel Military Industries' Negev is one of a breed of lightweight automatic weapons that has blurred the distinction between LMG and GPMG. Chambered for the SS109 NATO bullet in 5.56mm calibre, it can deliver automatic fire at 700 or 900 rounds per minute (rpm).

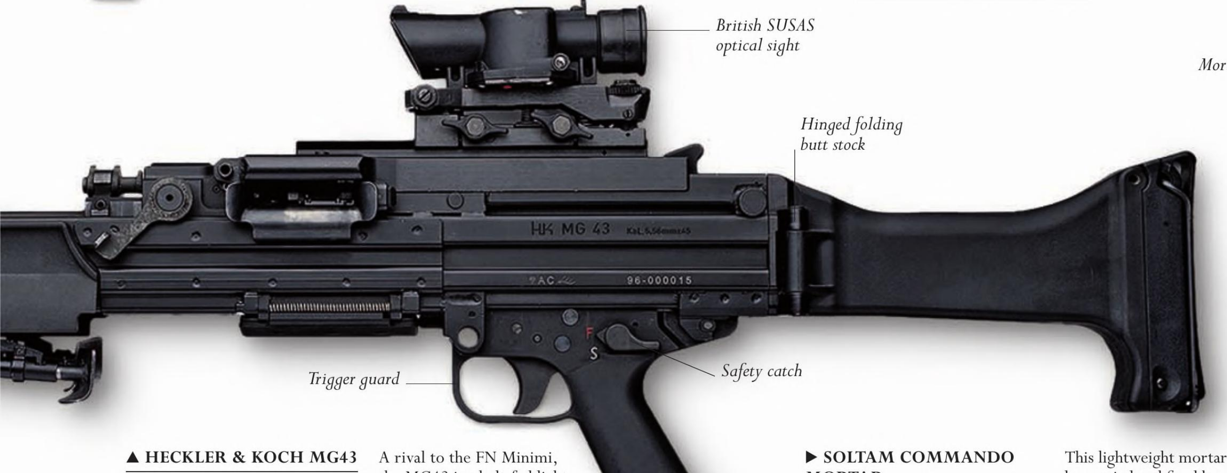

Optical sight
Six-chambered cylinder
Folding butt stock (open)


Fore sight
Barrel
Bipod folded under gas cylinder

▲ MILKOR MGL

Date	1983
Origin	South Africa
Weight	5.3kg (11¾lb)
Barrel	30cm (11¾in)
Calibre	40mm
Range	350m (382¾ yards)
Grenade type	HE, HEAT, anti-personnel, pyrotechnic

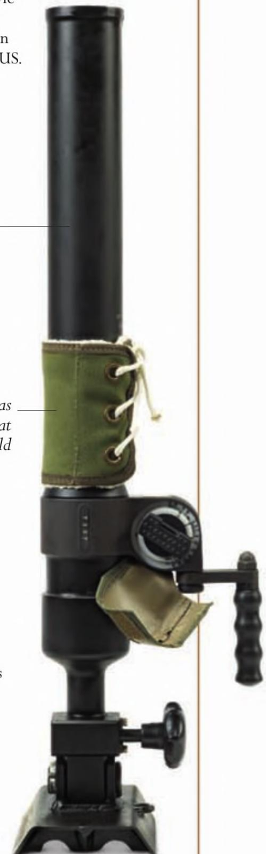
The Milkor is a semiautomatic multiple grenade launcher (MGL) that fires its projectiles from a six-chambered revolver-style magazine. The Milkor has been exported to more than 30 countries, including the US.


British SUSAS optical sight
Hinged folding butt stock
HK MG 43
Trigger guard
Safety catch

▲ HECKLER & KOCH MG43

Date	2001
Origin	Germany
Weight	8.55kg (18¾lb)
Barrel	48cm (18¾in)
Calibre	5.56 × 45mm

A rival to the FN Minimi, the MG43 is a belt-fed light machine-gun that features a folding butt stock and a quick-change barrel. In a slightly modified form, it has been designated the MG4 by the German army.


Mortar tube
Canvas heat shield

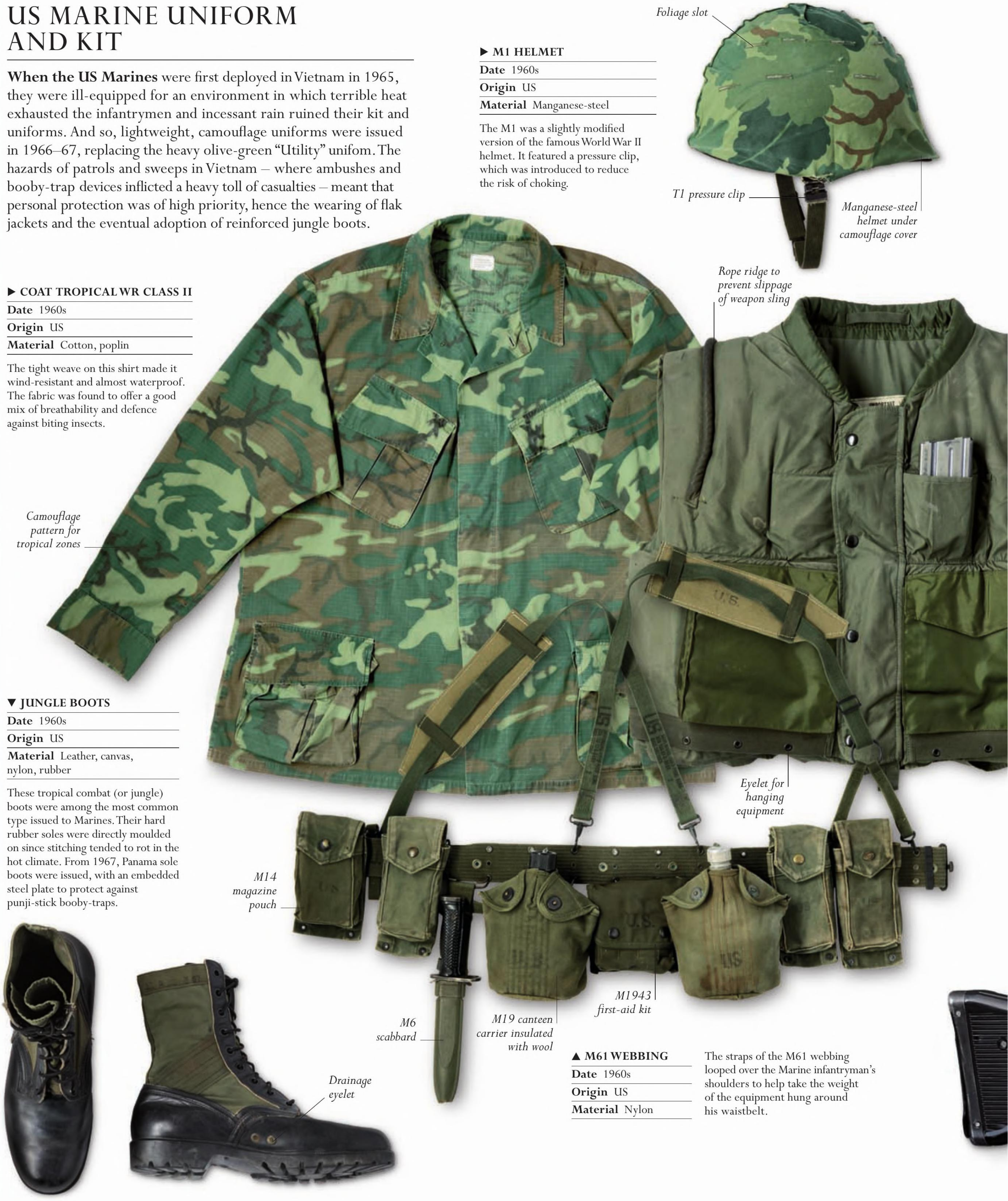
▶ SOLTAM COMMANDO MORTAR

Date	2006
Origin	Israel
Weight	6.2kg (13¾lb)
Length	53.3cm (21in)
Calibre	60mm
Range	800m (874¾ yards)

This lightweight mortar can be carried and fired by a single person. Its high rate of fire – up to 16 rounds per minute – makes it a valuable asset for infantry.

US MARINE UNIFORM AND KIT

When the US Marines were first deployed in Vietnam in 1965, they were ill-equipped for an environment in which terrible heat exhausted the infantrymen and incessant rain ruined their kit and uniforms. And so, lightweight, camouflage uniforms were issued in 1966–67, replacing the heavy olive-green "Utility" unifom. The hazards of patrols and sweeps in Vietnam – where ambushes and booby-trap devices inflicted a heavy toll of casualties – meant that personal protection was of high priority, hence the wearing of flak jackets and the eventual adoption of reinforced jungle boots.


Foliage slot
T1 pressure clip
Manganese-steel helmet under camouflage cover
Rope ridge to prevent slippage of weapon sling
Camouflage pattern for tropical zones
Eyelet for hanging equipment
M14 magazine pouch
M1943 first-aid kit
M6 scabbard
M19 canteen carrier insulated with wool
Drainage eyelet

▶ M1 HELMET

Date 1960s

Origin US

Material Manganese-steel

The M1 was a slightly modified version of the famous World War II helmet. It featured a pressure clip, which was introduced to reduce the risk of choking.

▶ COAT TROPICAL WR CLASS II

Date 1960s

Origin US

Material Cotton, poplin

The tight weave on this shirt made it wind-resistant and almost waterproof. The fabric was found to offer a good mix of breathability and defence against biting insects.

▼ JUNGLE BOOTS

Date 1960s

Origin US

Material Leather, canvas, nylon, rubber

These tropical combat (or jungle) boots were among the most common type issued to Marines. Their hard rubber soles were directly moulded on since stitching tended to rot in the hot climate. From 1967, Panama sole boots were issued, with an embedded steel plate to protect against punji-stick booby-traps.

▲ M61 WEBBING

Date 1960s

Origin US

Material Nylon

The straps of the M61 webbing looped over the Marine infantryman's shoulders to help take the weight of the equipment hung around his waistbelt.

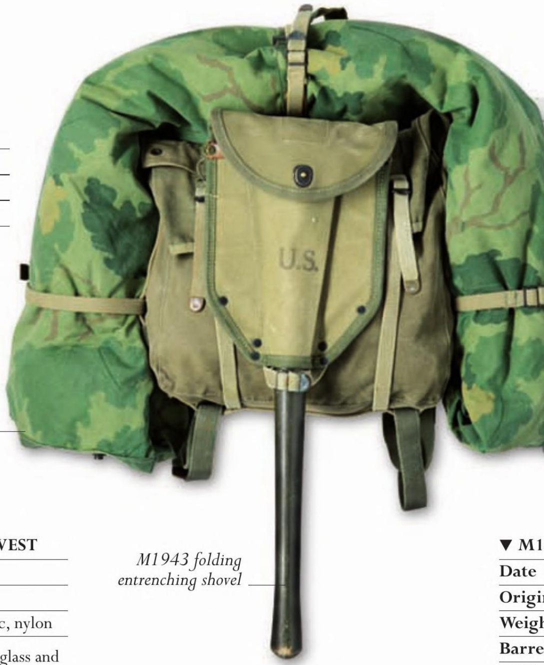
▶ 1941 PACK

Date 1941

Origin US

Material Nylon, cotton

This small pack was used to hold rations and personal effects, while the rolled sheet of camouflage canvas formed half of a "pup" tent when joined to a second sheet.



Mitchell-pattern camouflage issued only to Marine Corps

M1943 folding entrenching shovel

SAIGON FACILITIES MAP

MAP OF SAIGON BASE AREA

PARACHUTE FLARE

ANGLE HEAD FLASHLIGHT

◀ M1955 ARMOURED VEST

Date 1960s

Origin US

Material Fibreglass, plastic, nylon

The Doron-armoured (fibreglass and plastic) vest – heavy and unsuitable for tropical conditions – would have little chance of stopping a bullet, but it was an effective defence against shrapnel.

▼ M14 RIFLE

Date 1959

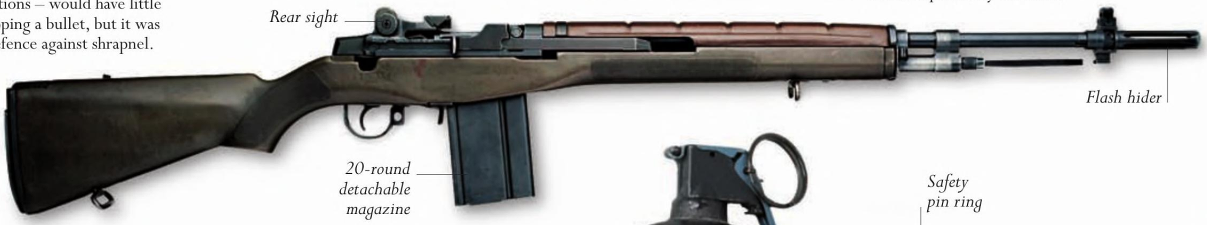
Origin US

Weight 4.4kg (9¾lb)

Barrel 55.8cm (22in)

Calibre 7.62mm

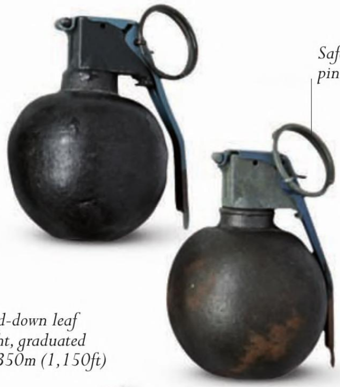
Designed to use the then-standard NATO round, the US M14 replaced the old M1 rifle. The M14 possessed a fully automatic fire capability and was equipped with a larger magazine. By the late 1960s, it was replaced by the M16.



Rear sight

Flash hider

20-round detachable magazine



Safety pin ring

◀ M67 GRENADES

Date 1960s

Origin US

Weight 0.45kg (1lb)

Length 89mm (3½in)

The M67 "baseball" grenade had a notched-wire interior designed to fragment into many small pieces on the detonation of its high-explosive charge.

▼ M79 GRENADE LAUNCHER

Date 1961

Origin US

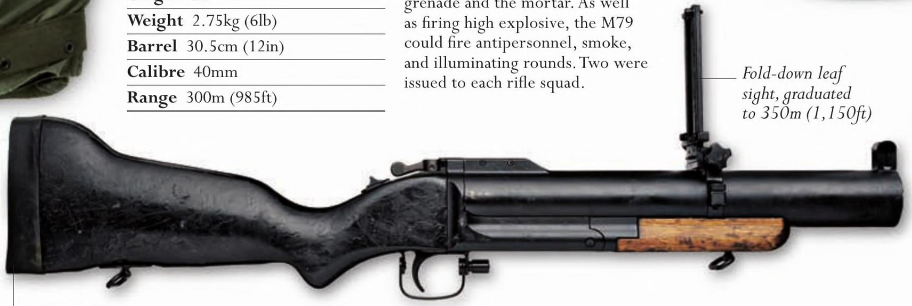
Weight 2.75kg (6lb)

Barrel 30.5cm (12in)

Calibre 40mm

Range 300m (985ft)

With a maximum range of 300m (985ft), the M79 grenade launcher bridged the gap between the hand grenade and the mortar. As well as firing high explosive, the M79 could fire antipersonnel, smoke, and illuminating rounds. Two were issued to each rifle squad.



Fold-down leaf sight, graduated to 350m (1,150ft)

Rubber pad absorbs recoil

▼ M60 MACHINE-GUN

Date 1963

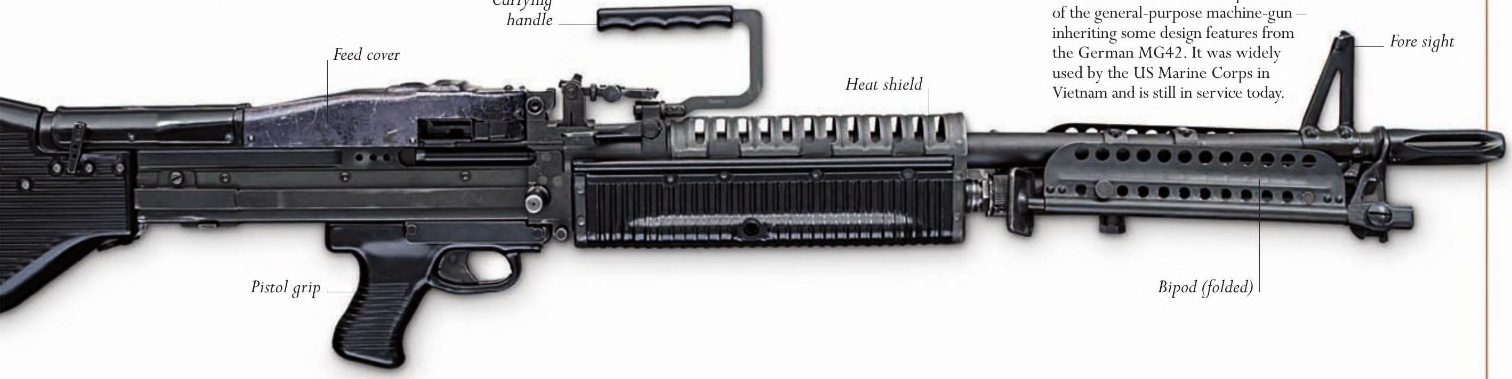
Origin US

Weight 10.51kg (23lb)

Barrel 59.9cm (23½in)

Calibre 7.62mm

The M60 was the US example of the general-purpose machine-gun – inheriting some design features from the German MG42. It was widely used by the US Marine Corps in Vietnam and is still in service today.



Carrying handle

Feed cover

Heat shield

Fore sight

Pistol grip

Bipod (folded)

SOLDIERS ON PATROL
US troops continue a "Search and Destroy" patrol in Vietnam, while an armoured vehicle secures the helicopter landing area. The strategy was to airlift in troops to destroy the enemy and their supplies, then airlift troops out again, instead of taking and holding enemy territory.

CLOSE AIR SUPPORT

OPERATION CEDAR FALLS

American ground troops were committed to a war against communist guerrillas in South Vietnam in 1965. US commander General William Westmoreland adopted an aggressive strategy, directing forces in large-scale "search and destroy" operations in guerrilla-controlled areas. Operation Cedar Falls in January 1967 exemplified the successes and failures of this approach.

Operation Cedar Falls was directed against the Iron Triangle, a guerrilla stronghold 40km (25 miles) from the South Vietnamese capital Saigon. Over many years the guerrillas had fortified the area with a complex system of tunnels protected by boobytraps and concealed firing positions. The Americans planned to encircle and destroy the guerrillas in a "hammer and anvil" operation. Troops along the southwest side of the Triangle would be the "anvil", blocking the guerrillas' escape as they were hit by the "hammer" – forces attacking from the north and east. The plan relied on helicopters to lift infantry swiftly into their combat positions, thereby bypassing difficult forested terrain and avoiding possible ambushes to convoys on roads. Helicopter gunships were not yet available, but the infantry received supporting firepower from tactical bombers, fixed-wing gunships, and artillery firebases.

The operation began on 8 January with the placing of the "anvil" forces, including elements of the South Vietnamese Army. One of the first objectives was to secure the village of Ben Suc, considered a hotbed of guerrilla activity. A flight of 60 helicopters zoomed in at treetop level and landed an entire American infantry battalion at positions around the village, which was then occupied with only light casualties. Other airmobile formations and mechanized infantry executed the "hammer" element of the operation over the following days. Travelling in M113 armoured personnel carriers, the mechanized infantry were protected against the antipersonnel mines and sniping that took such a toll on soldiers on foot patrol. Newly introduced Rome ploughs, designed for heavy land-clearance, carved swathes through the jungle, while specially trained and equipped soldiers were sent in to search the dark maze of tunnels. These "tunnel rats" found caches of weapons and munitions, uniforms, food dumps, and an abundance of documents valuable to US intelligence.

DESTRUCTION OF RESOURCES

The Americans and South Vietnamese allies went on to render the Iron Triangle unusable for guerrilla forces. Tunnels were filled with acetylene gas and blown up, while much of the area was sprayed from the air with Agent Orange herbicide, poisoning forest and agricultural land. The peasant population was evacuated at gunpoint to refugee camps and Ben Suc was totally destroyed, the buildings burned, then flattened by bulldozers. But the objective of locating and destroying communist soldiers largely failed. The lightly equipped guerrillas were expert at concealment and slipped through the US cordon. The combination of the Americans' firepower and mobility allowed them to clear populated regions of guerrillas – but at the cost of devastating the peasant society that sustained them and laying waste to land US troops were deployed to defend. What American forces could not do was bring enemy formations to decisive combat and destroy them.

HELICOPTERS

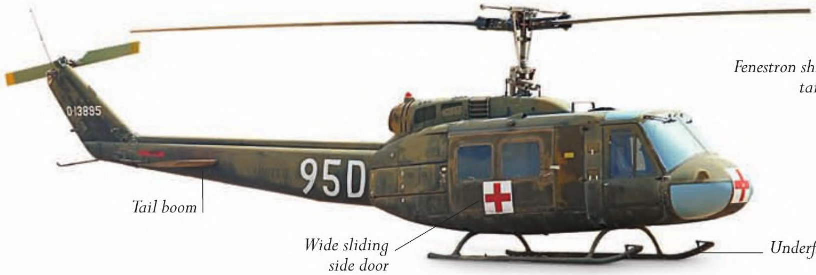
The helicopter has been a major force in transforming warfare on the modern battlefield. Transport helicopters – such as the CH-47 Chinook and the UH-60 Black Hawk – are able to deliver heavy stores to forward troops, and having no need for a runway they can do this in almost any type of terrain. More important still has been the introduction of the attack helicopter, or "helicopter gunship", which provides close air support to ground troops and targets enemy armour. The Russian MI-24 Hind is a rare hybrid – a gunship that doubles up as a troop carrier.

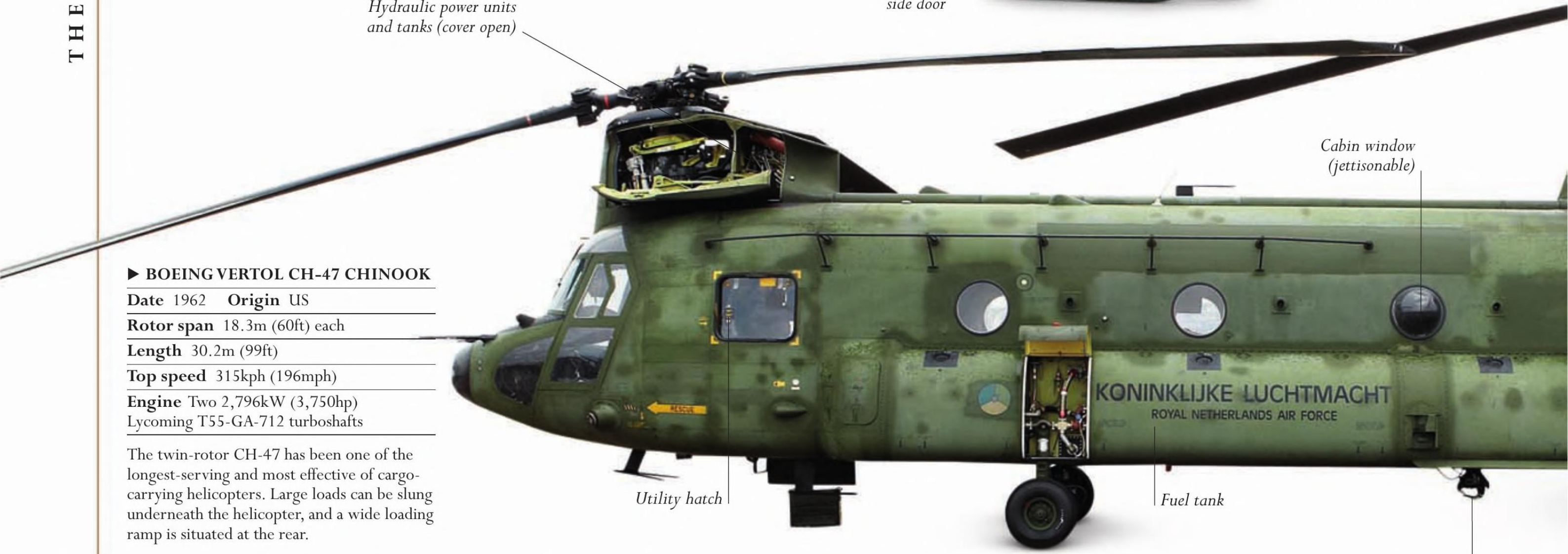
▼ BELL UH-1 IROQUOIS

Date	1959
Origin	US
Rotor span	14.63m (48ft)
Length	17.4m (57ft)
Top speed	217kph (135mph)
Engine	820kW (1,100hp) Lycoming T53-L-11 turboshaft

The UH-1 "Huey" – which first saw service during the Vietnam War – was a workhorse of the US Army, operating in many roles, including gunship, troop transport, search and rescue, liaison, and casualty evacuation.

Fenestron shrouded tail rotor

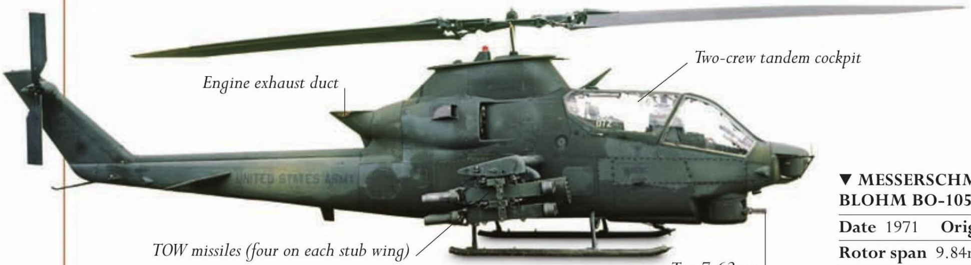

Tail boom
Wide sliding side door
Underfloor skids
0-13895
95D


Hydraulic power units and tanks (cover open)
Cabin window (jettisonable)
Utility hatch
Fuel tank
Cargo hook
KONINKLIJKE LUCHTMACHT
ROYAL NETHERLANDS AIR FORCE

► BOEING VERTOL CH-47 CHINOOK

Date	1962
Origin	US
Rotor span	18.3m (60ft) each
Length	30.2m (99ft)
Top speed	315kph (196mph)
Engine	Two 2,796kW (3,750hp) Lycoming T55-GA-712 turboshafts

The twin-rotor CH-47 has been one of the longest-serving and most effective of cargo-carrying helicopters. Large loads can be slung underneath the helicopter, and a wide loading ramp is situated at the rear.


Engine exhaust duct
Two-crew tandem cockpit
TOW missiles (four on each stub wing)
Two 7.62mm miniguns
UNITED STATES ARMY

▲ BELL AH-1 COBRA

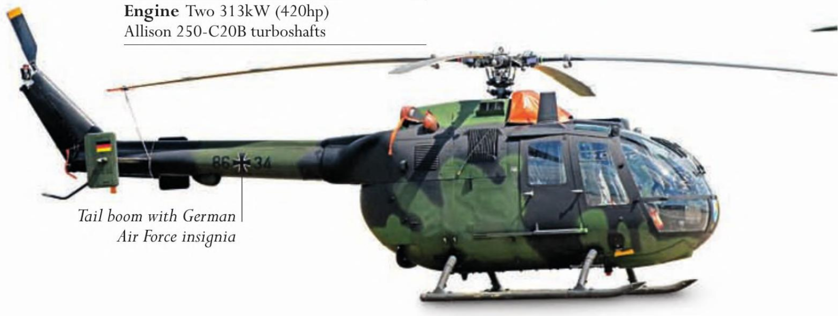
Date	1967
Origin	US
Rotor span	13.6m (44ft)
Length	16.1m (52.3ft)
Top speed	315kph (196mph)
Engine	1,300kW (1,800hp) Lycoming T53-L-703 turboshaft

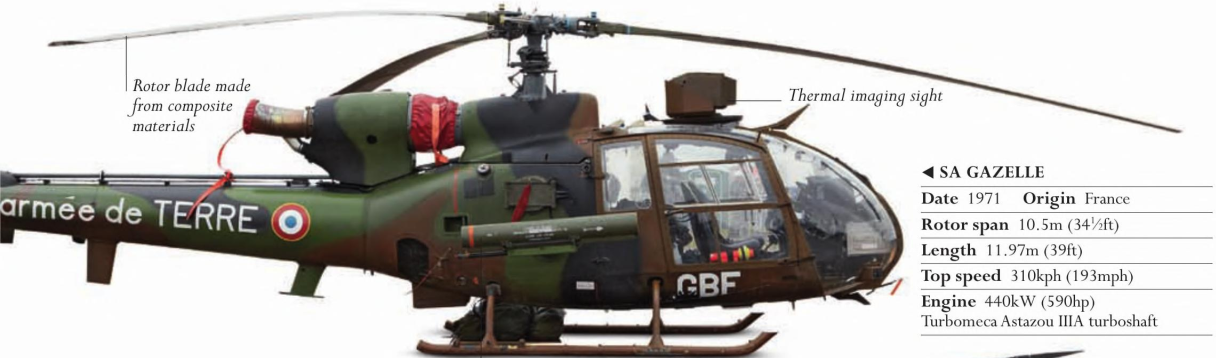
The first dedicated gunship – with a fighter-style two-man cockpit – the AH-1 Cobra proved highly effective in Vietnam, providing close fire support to slower and more vulnerable helicopters such as the UH-1.

▼ MESSERSCHMITT-BÖLKOW-BLOHM BO-105

Date	1971
Origin	West Germany
Rotor span	9.84m (32¼ft)
Length	11.86m (39ft)
Top speed	270kph (167mph)
Engine	Two 313kW (420hp) Allison 250-C20B turboshafts

The BO-105 was the first helicopter to offer the safety provided by twin engines. Its low weight and agile performance were combined with a potent punch provided by six HOT (High subsonic Optical remote-guided fired from Tube) anti-tank missiles.


Tail boom with German Air Force insignia
86+34


Rotor blade made from composite materials
Thermal imaging sight
TOW anti-tank missile tube

◀ SA GAZELLE

Date 1971 **Origin** France

Rotor span 10.5m (34½ft)

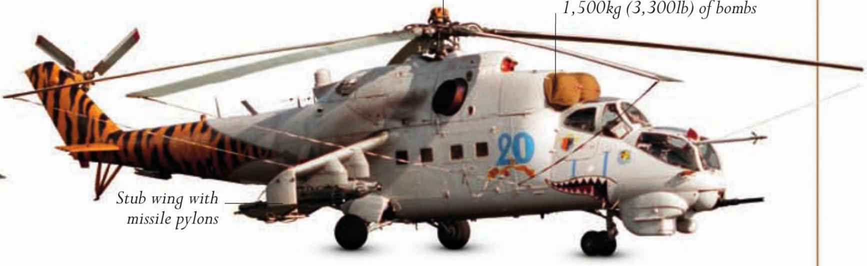
Length 11.97m (39ft)

Top speed 310kph (193mph)

Engine 440kW (590hp) Turbomeca Astazou IIIA turboshaft

A lightweight utility helicopter produced for the French army, the Gazelle was also produced in the UK. Variants were armed with TOW (Tube-launched, Optically tracked, Wire-guided) anti-tank missiles, 20mm cannon, and Mistral air-to-air missiles.

Turboshaft engine (cover raised)
Loading ramp (raised)


Titanium rotor head
Armed with a 12.7mm Gatling gun, plus window-mounted machine-guns, rocket launchers, and up to 1,500kg (3,300lb) of bombs
Stub wing with missile pylons

▲ MIL MI-24 HIND

Date 1973 **Origin** Soviet Union

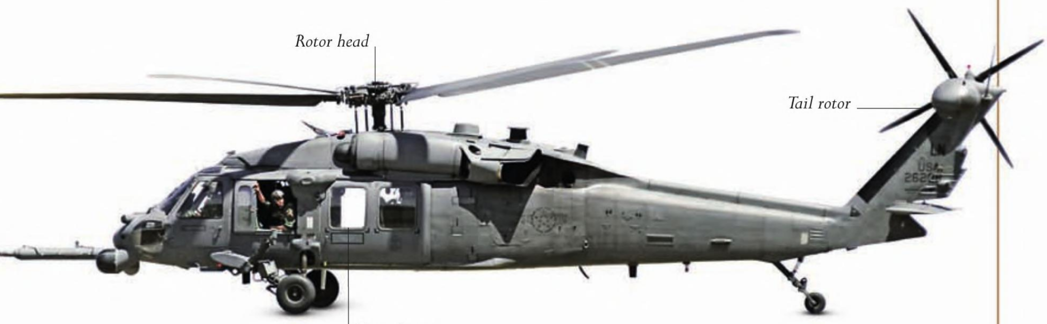
Rotor span 17.3m (56½ft)

Length 17.5m (57¼ft)

Top speed 346kph (215mph)

Engine Two 1,641kW (2,200hp) Isotov TV3-117 turboshafts

The Hind is a very large gunship and troop transporter. Its armament includes a rotary-barrel heavy machine-gun under the nose, as well as under-wing pylons for a variety of missile types.


Rotor head
Tail rotor
Troop/cargo compartment

▶ SIKORSKY UH-60 BLACK HAWK

Date 1979 **Origin** US

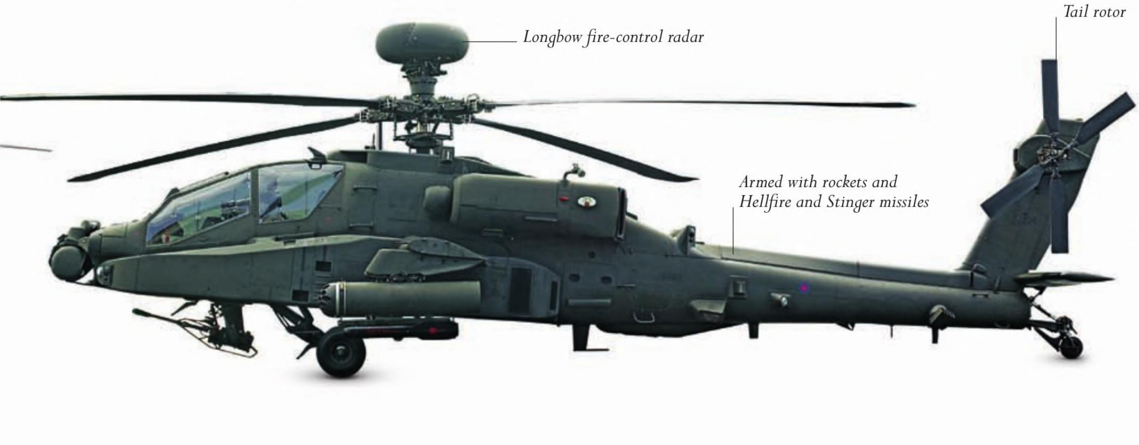
Rotor span 16.36m (53¾ft)

Length 19.76m (64¾ft)

Top speed 357kph (222mph)

Engine Two 1,410kW (1,890hp) GE T700-GE-701C turboshafts

The UH-60 is a twin-engined utility helicopter able to ferry up to 14 soldiers, carry cargo, and evacuate up to six stretcher cases at a time. It can also be configured as a gunship.


Longbow fire-control radar
Tail rotor
Armed with rockets and Hellfire and Stinger missiles

◀ APACHE AH MK1

Date 2004 **Origin** UK

Rotor span 14.6m (48ft)

Length 17.7m (58¼ft)

Top speed 365kph (227mph)

Engine Two 1,566kW (2,100hp) Rolls-Royce RTM322 turboshafts

The Apache AH Mk1 (or AugustaWestland Apache) is the UK version of the Boeing AH-64D Apache Longbow helicopter. It has been successfully deployed by the British Armed Forces in Afghanistan (see pp.436–37).

ATTACK/RECONNAISSANCE HELICOPTER

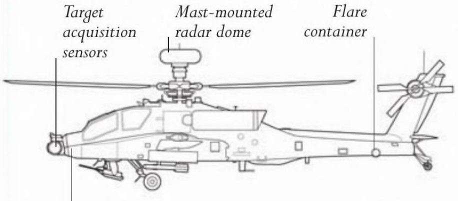
AH-64 APACHE

The anti-armour AH-64 is used by a number of the world's armed forces. It employs many of the offensive and defensive technologies that dominate the modern battlefield.

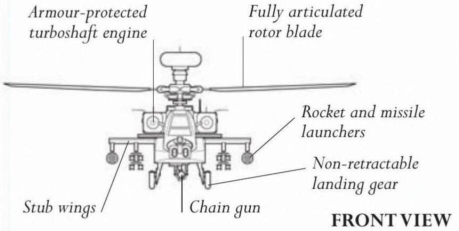
Initially developed by Hughes Helicopters and now produced by Boeing, the twin-engined AH-64 Apache was introduced in 1984. It performed well in the Gulf War of 1991 and subsequently during the invasions of Afghanistan in 2001 and Iraq in 2003. Shown here is the AH1 – a version of Boeing's AH-64D Apache Longbow built under licence by AugustaWestland for the British Army.

The Apache's weaponry includes a chain gun, rockets, and its primary armament of Hellfire missiles. Using target-acquisition and fire-control systems, the crew can merely select targets and fire; the missiles will then lock on to the targets and do the rest. This "fire-and-forget" capacity allows the Apache to take evasive action as soon as it has launched its own weapons.

To make this slow-flying helicopter less vulnerable in battle, the Apache is equipped with a variety of defensive systems. These include the suppression of infrared radiation (to avoid detection by hostile heat-seeking missiles), and sensors that give advance warning of incoming threats.


Target acquisition sensors
Mast-mounted radar dome
Flare container
HIDAS sensors

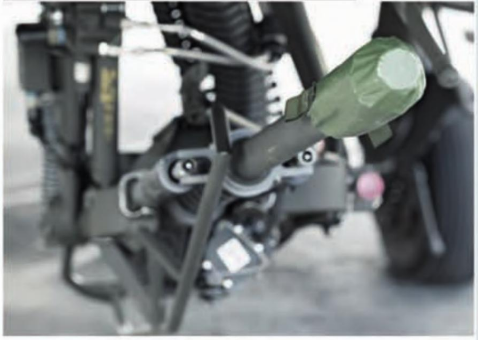
SIDE VIEW


Armour-protected turboshaft engine
Fully articulated rotor blade
Rocket and missile launchers
Non-retractable landing gear
Stub wings
Chain gun

FRONT VIEW

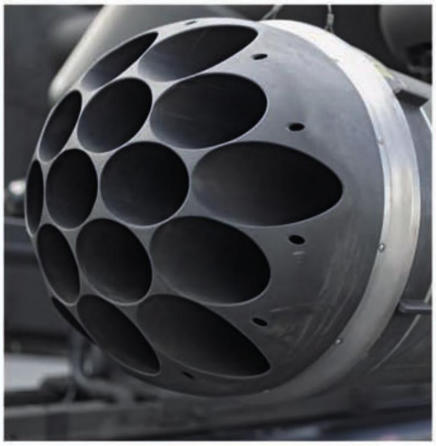
▲ **AH-64D APACHE LONGBOW**
The helicopter's fuselage is 15.5m (51ft) in length and the main rotor diameter measures 14.6m (48ft). With a range of 537km (334 miles), the Apache has a cruising speed of around 260kph (162mph).

WEAPONS SYSTEMS



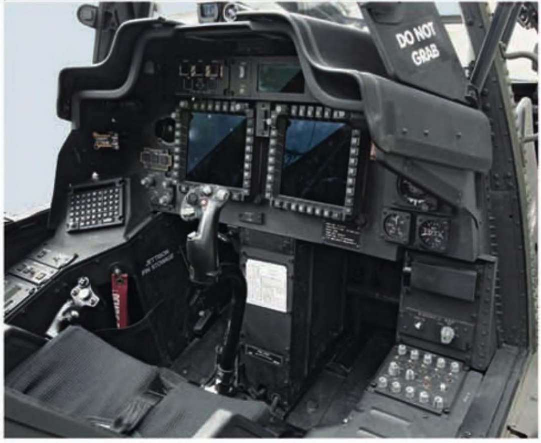
▲ **30MM CHAIN GUN**
The Hughes M230 chain gun can fire 625 rounds per minute, fed from a 1,200-round magazine by an electrically driven chain mechanism.

▲ **MISSILE**
Up to 16 Hellfire guided missiles can be carried (a training round is shown above). These anti-armour weapons have a range of 8km (5 miles).

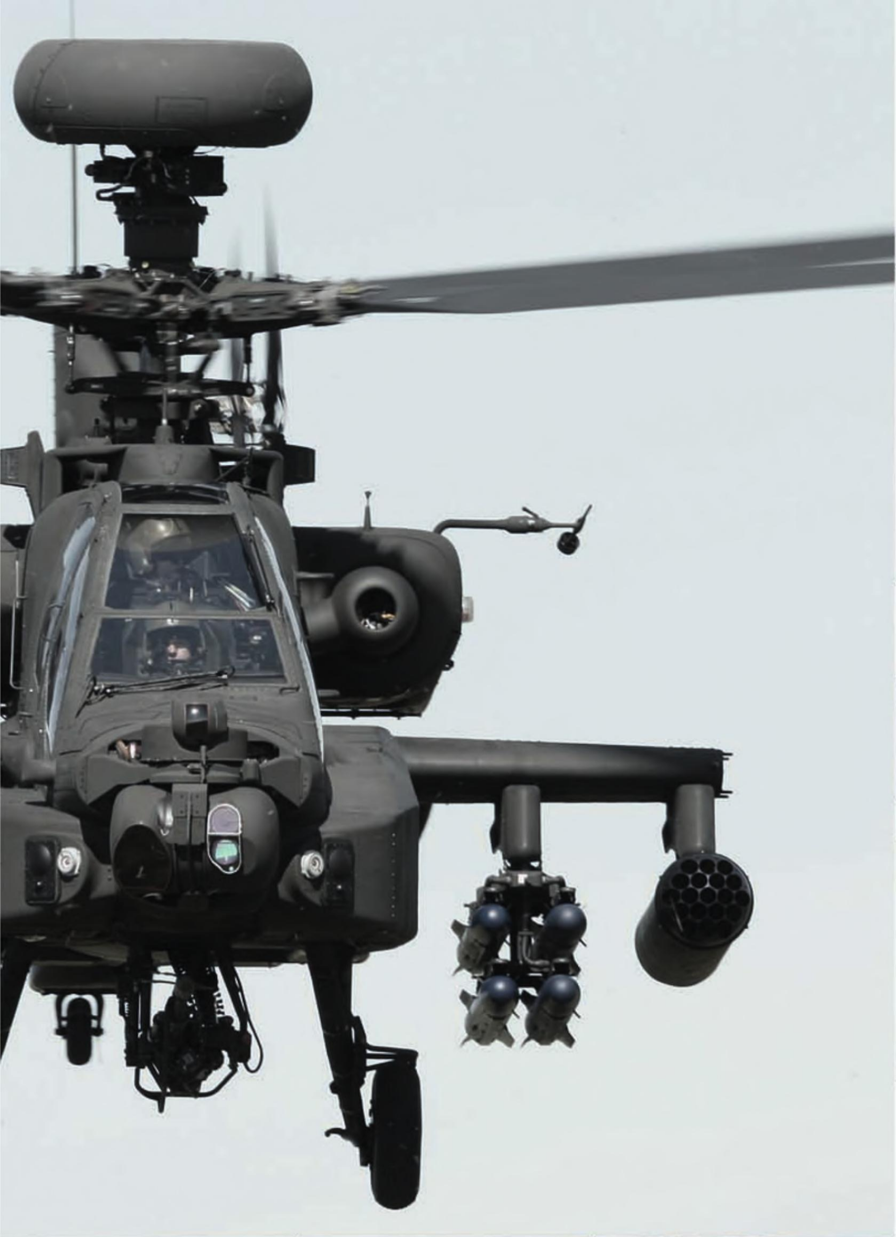


▲ **ROCKET POD**
Mounted under the wings, the two rocket pods are for use against infantry and light armour. Each one can launch 19 unguided 70mm rockets.

PILOT'S COCKPIT



▲ **INSTRUMENT PANELS**
The pilot sits above and behind the co-pilot/gunner. All the helicopter's systems are displayed in both cockpits and managed using the buttons around the screens.



◂ RADAR "HAT"
The hat-like structure above the main rotor is the Longbow radar. It gives the crew a 360-degree electronic picture of the battlefield, regardless of conditions, and locates enemy targets.

HELICOPTER EXTERIOR

◂ HIDAS SENSORS
The Helicopter Integrated Defensive Aids System (HIDAS) automatically detects and responds to enemy missiles.

◂ MAIN ROTOR ASSEMBLY
The rotor blades are attached to the hub by laminated steel straps. The blades can easily be folded or removed for transportation by air or ship.

▴ WIRE CUTTER
Blades on the airframe can cut through power cables and telephone wires that could bring the craft down.

▴ FLARE CONTAINER
Decoy flares housed near the tail are fired by the helicopter's automatic defence system to confuse hostile missiles.

◂ PILOT'S MONOCLE
The monocle provides thermal (infrared) imaging and flight information in all conditions.

CANOPY
JETTISON
TURN
90°
PUSH

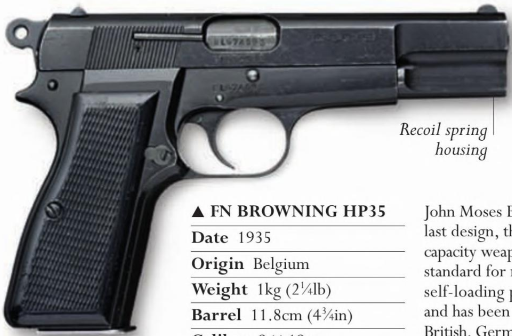
▴ CANOPY JETTISON
The armoured cockpit canopy can be jettisoned in an emergency.

▴ SAFETY BELT
An array of safety features gives the crew a good chance of surviving crash landings.

◂ CONTROL STICK
Both pilot and gunner have flight and weapons controls. They can take over from each other if necessary.

SPECIAL FORCES WEAPONS

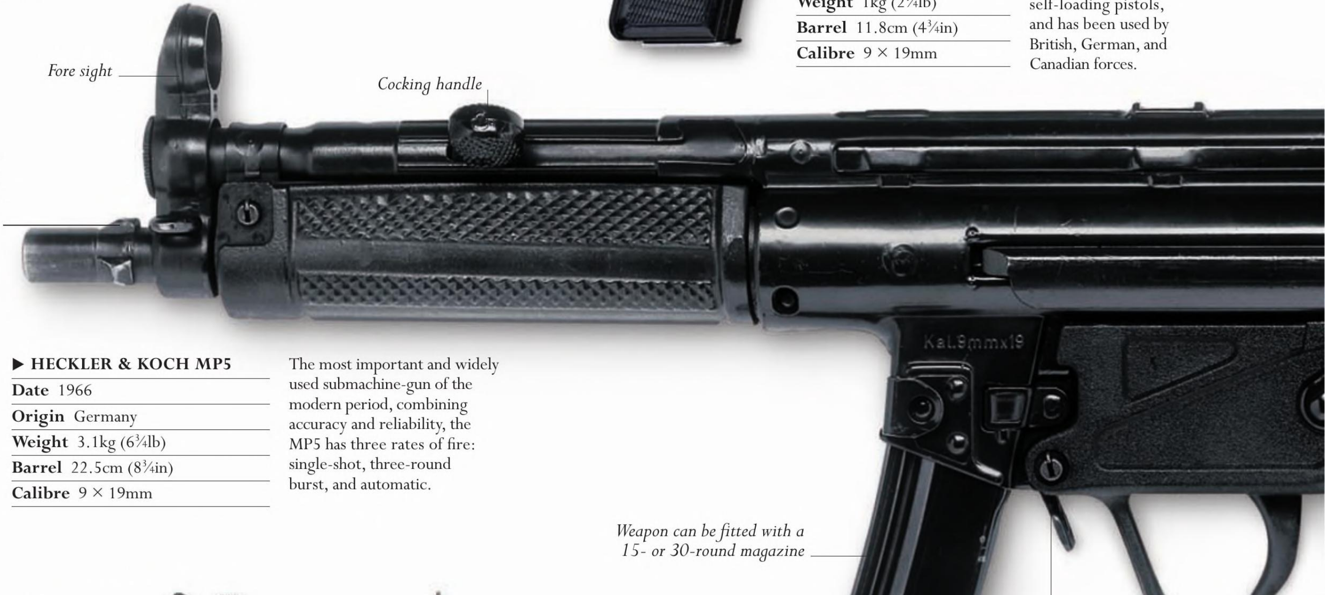
Special Forces units are sometimes required to deploy specialist weapons. Rock-solid reliability is a precondition for any such selection; a high-level of firepower makes small arms such as the Franchi shotgun and the Glock pistol popular choices. At other times stealth weapons are needed. But the most interesting recent development has been the introduction of the Personal Defense Weapon (PDW), such as the FN P90. This dispenses with the old Parabellum submachine-gun cartridge in favour of a smaller but more powerful round that can penetrate body armour.


Recoil spring housing

▲ FN BROWNING HP35

Date 1935
Origin Belgium
Weight 1kg (2¼lb)
Barrel 11.8cm (4¾in)
Calibre 9 × 19mm

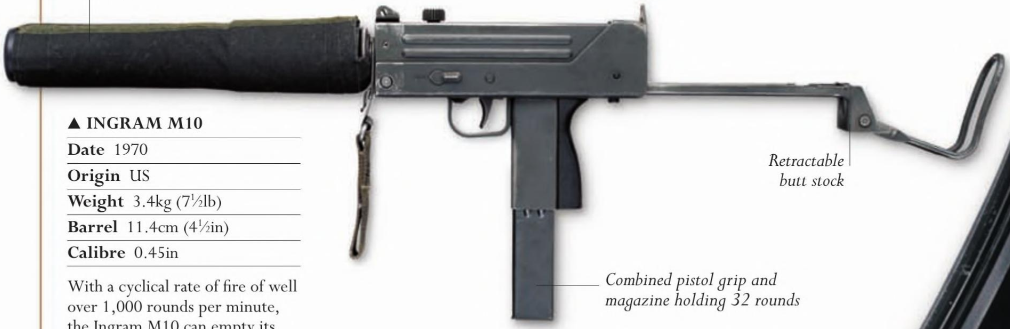
John Moses Browning's last design, this high-capacity weapon set the standard for modern self-loading pistols, and has been used by British, German, and Canadian forces.


Fore sight
Cocking handle
Attachment lugs for barrel-mounted accessories such as a suppressor
Kal.9mmx19
Weapon can be fitted with a 15- or 30-round magazine
Magazine release catch

▶ HECKLER & KOCH MP5

Date 1966
Origin Germany
Weight 3.1kg (6¾lb)
Barrel 22.5cm (8¾in)
Calibre 9 × 19mm

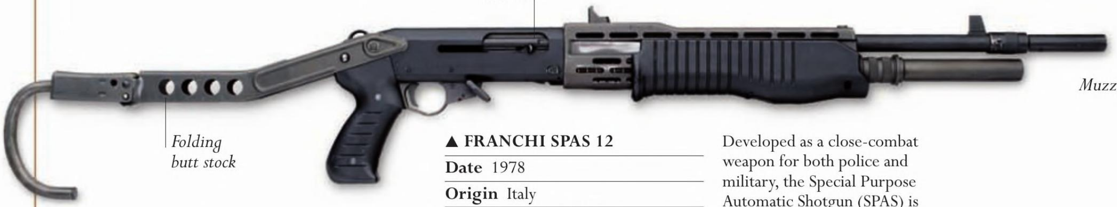
The most important and widely used submachine-gun of the modern period, combining accuracy and reliability, the MP5 has three rates of fire: single-shot, three-round burst, and automatic.


Suppressor
Retractable butt stock
Combined pistol grip and magazine holding 32 rounds

▲ INGRAM M10

Date 1970
Origin US
Weight 3.4kg (7½lb)
Barrel 11.4cm (4½in)
Calibre 0.45in

With a cyclical rate of fire of well over 1,000 rounds per minute, the Ingram M10 can empty its magazine in just over a second. The suppressor is essential to retain control over firing.

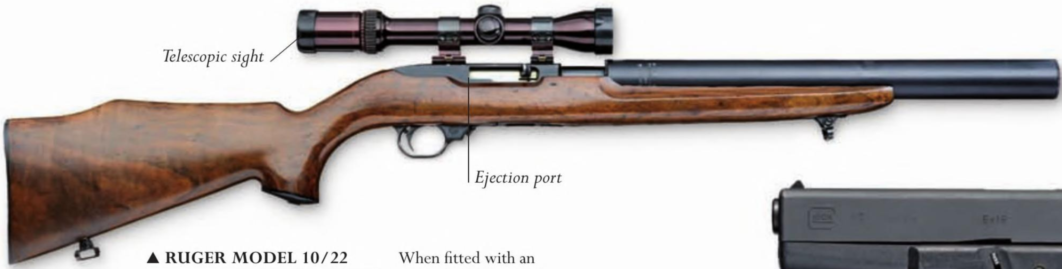

Cocking handle
Folding butt stock

▲ FRANCHI SPAS 12

Date 1978
Origin Italy
Weight 4.4kg (9¾lb)
Barrel 54.5cm (21½in)
Calibre 12-bore

Developed as a close-combat weapon for both police and military, the Special Purpose Automatic Shotgun (SPAS) is gas-operated (with an optional pump mode) and holds eight rounds in an under-barrel tubular magazine.

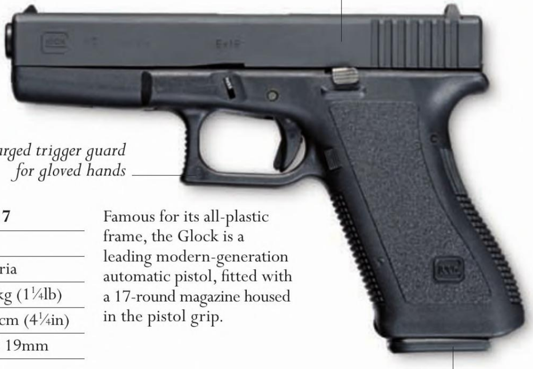
Optical sight
P90 cal 5.7x28
Muzzle


Telescopic sight
Ejection port

▲ RUGER MODEL 10/22

Date	1980s
Origin	US
Weight	2.8 kg (6¼lb)
Barrel	47cm (18½in)
Calibre	0.22in

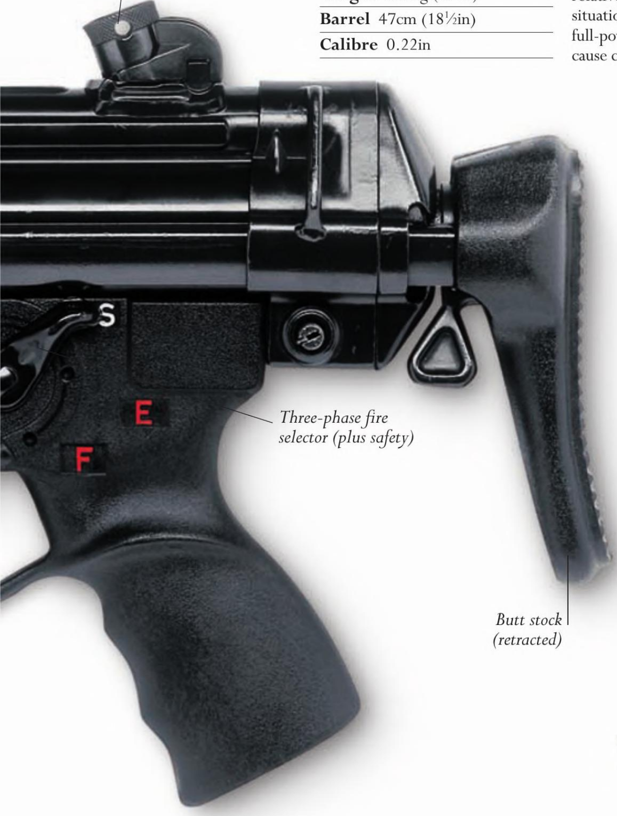
When fitted with an integral suppressor, the 10/22 fires a lightweight bullet that is useful in relatively close-range situations, where a full-power cartridge could cause collateral damage.

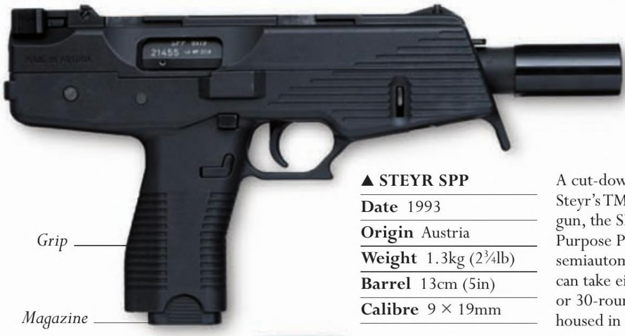

Plastic body
Enlarged trigger guard for gloved hands
Magazine

▶ GLOCK 17

Date	1982
Origin	Austria
Weight	0.6kg (1¼lb)
Barrel	11.4cm (4½in)
Calibre	9 × 19mm

Famous for its all-plastic frame, the Glock is a leading modern-generation automatic pistol, fitted with a 17-round magazine housed in the pistol grip.

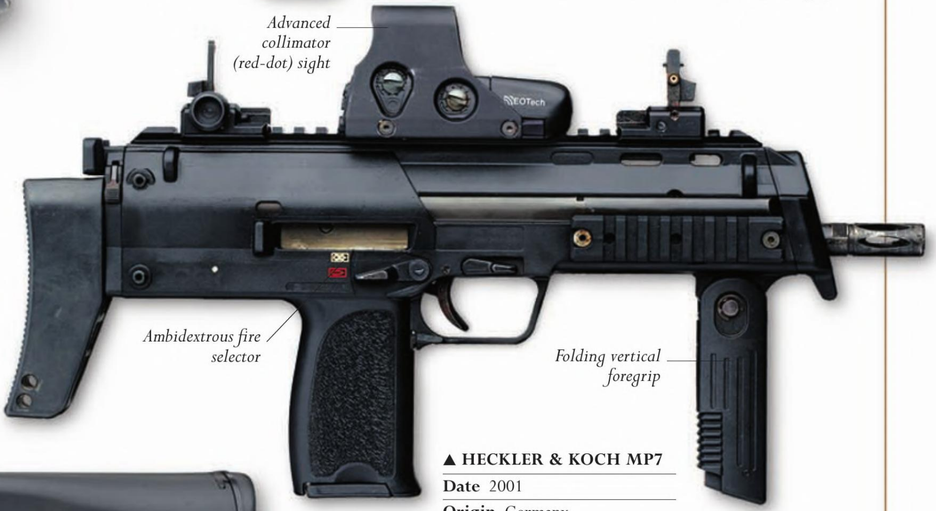

Rear sight
Three-phase fire selector (plus safety)
Butt stock (retracted)


Grip
Magazine

▲ STEYR SPP

Date	1993
Origin	Austria
Weight	1.3kg (2¾lb)
Barrel	13cm (5in)
Calibre	9 × 19mm

A cut-down version of Steyr's TMP submachine-gun, the SPP – or Special Purpose Pistol – fires on semiautomatic only, and can take either a 15- or 30-round magazine housed in the pistol grip.


Advanced collimator (red-dot) sight
Ambidextrous fire selector
Folding vertical foregrip

▼ FN P90

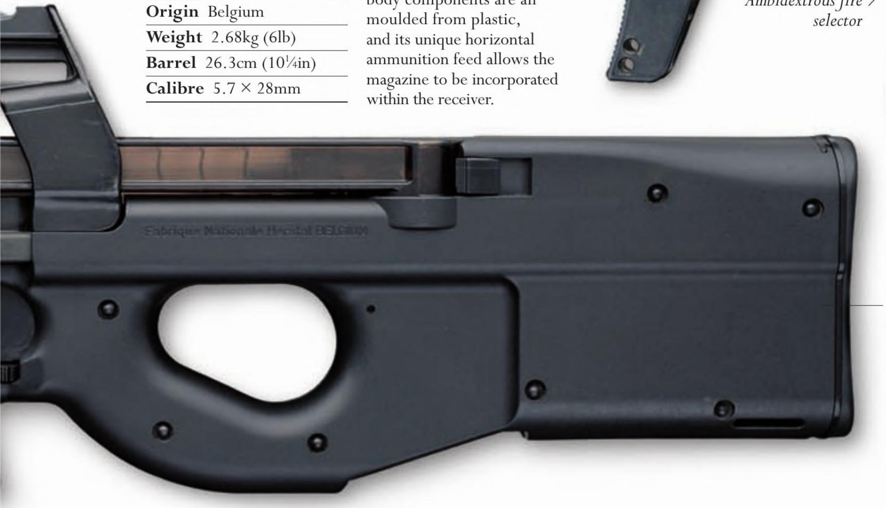
Date	1990
Origin	Belgium
Weight	2.68kg (6lb)
Barrel	26.3cm (10¼in)
Calibre	5.7 × 28mm

A ground-breaking PDW, the FN P90's non-mechanical body components are all moulded from plastic, and its unique horizontal ammunition feed allows the magazine to be incorporated within the receiver.

▲ HECKLER & KOCH MP7

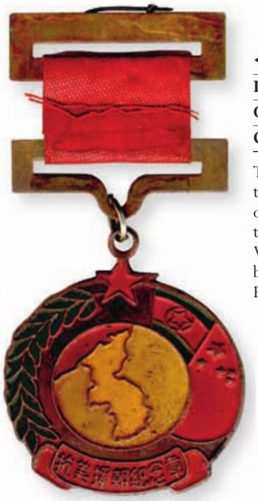
Date	2001
Origin	Germany
Weight	1.9kg (4¼lb)
Barrel	18cm (7in)
Calibre	4.6 × 30mm

Similar in concept to the FN P90, the MP7 is a PDW that fires one of the new-generation reduced calibre, high-velocity rounds, in this case the 4.6 × 30mm cartridge. The fully ambidextrous design accommodates both left- and right-handed operators.


Injection-moulded plastic butt stock houses receiver, bolt, and lock

MEDALS OF THE MODERN ERA

The fragmentation of the colonial empires and the rise of new nations led to different forms of conflict, often without defined battles, but for which the combatants needed to be recognized. Some military operations, such as in Korea and Kosovo, involved forces acting on behalf of international organizations, rather than countries, who therefore issued medals. While the nature of war was changing, traditional acts of valour continued to provide the grounds for the award of many long-standing medals.



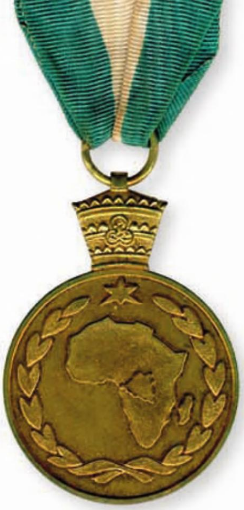
◀ LIAOHSI MEDAL

Date 1950

Origin China

Conflict Korean War

The distinctive bronze Liaohsi Medal for the Struggle to Resist the United States of America and Support Korea was issued to Chinese "volunteers" in the Korean War (1950–53). The enamelled front bears a map showing the Korean Peninsula and China.



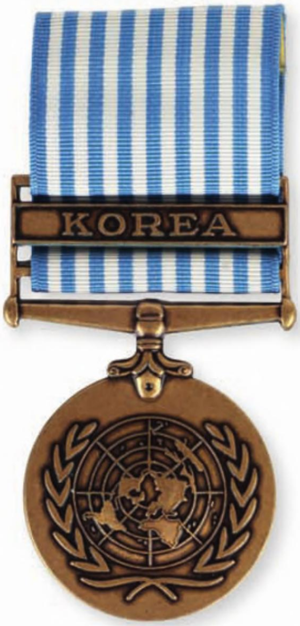
▲ ETHIOPIAN CONGO MEDAL

Date 1964

Origin Ethiopia

Conflict Congo Crisis

This medal was awarded to Ethiopians who served under the UN banner during the Congo Crisis of 1960–64. About 3,000 troops from the Imperial Bodyguard and part of an air squadron carried out peacekeeping duties.



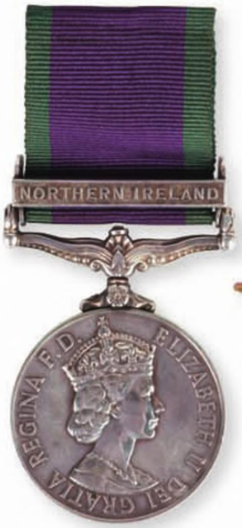
▶ UN KOREA MEDAL

Date 1950

Origin UK/United Nations

Conflict Korean War

Different versions of the UN Korea Medal were awarded to forces from each participating nation, although all shared the same ribbon. The British medal (shown) was issued to British and Commonwealth forces who had served at least one full day in Korea.

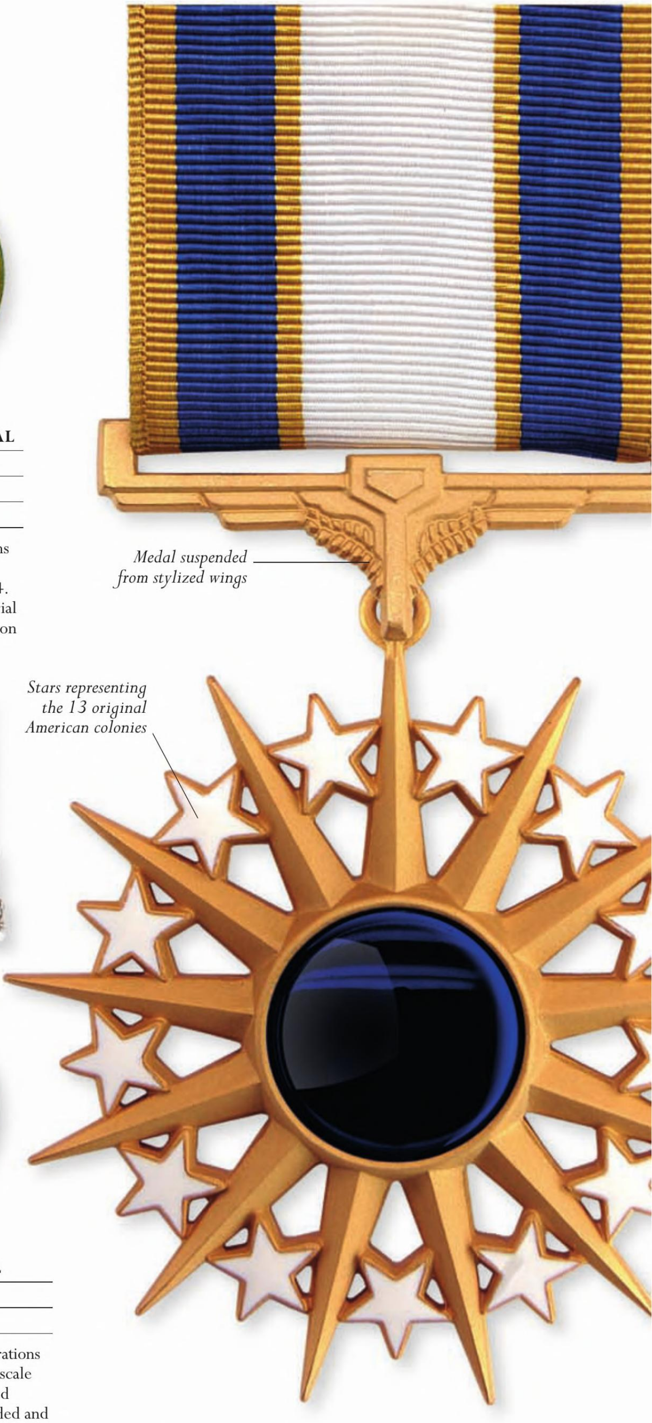


▲ GENERAL SERVICE MEDAL

Date 1962

Origin UK

This award was made for minor operations and campaigns – those short of full-scale war. It was open to all the UK armed services. Thirteen clasps were awarded and 130,000 medals with the Northern Ireland clasp (shown) were issued (1969–2007).



Medal suspended from stylized wings

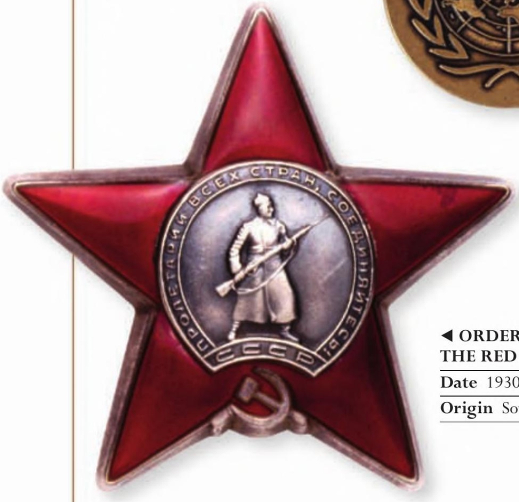
Stars representing the 13 original American colonies

▲ AIR FORCE DISTINGUISHED SERVICE MEDAL

Date 1960

Origin US

This medal has a sunburst motif with a central blue stone representing the sky. Generally issued to high-ranking officers, it is awarded for "exceptionally meritorious service in a duty of unique and great responsibility", in a combat or non-combat role.

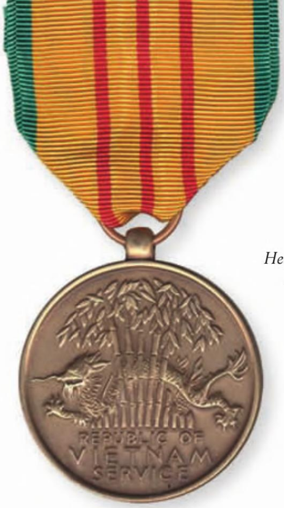


◀ ORDER OF THE RED STAR

Date 1930

Origin Soviet Union

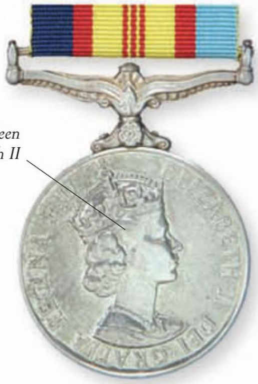
The Red Star was awarded for achievements in the defence of the Soviet Union (both in war and peace) in the fields of state security, military science, weapons development, and courage and valour in battle. More than 4 million people received the order of the Red Star, with the last award made in 1991.



▲ VIETNAM SERVICE MEDAL

Date 1965
Origin US
Conflict Vietnam War

Depicting an oriental dragon and a bamboo grove on the front, the Vietnam Service Medal was awarded to military personnel who took part in combat or support operations in Vietnam, Thailand, Laos, or Cambodia between 4 July 1965 and 28 March 1973.



Head of Queen Elizabeth II

▲ VIETNAM MEDAL

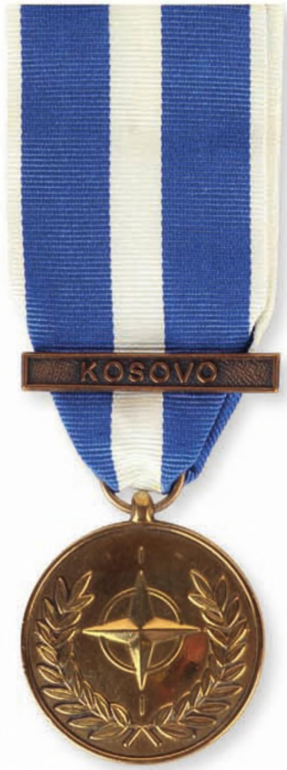
Date 1968
Origin Australia/New Zealand
Conflict Vietnam War

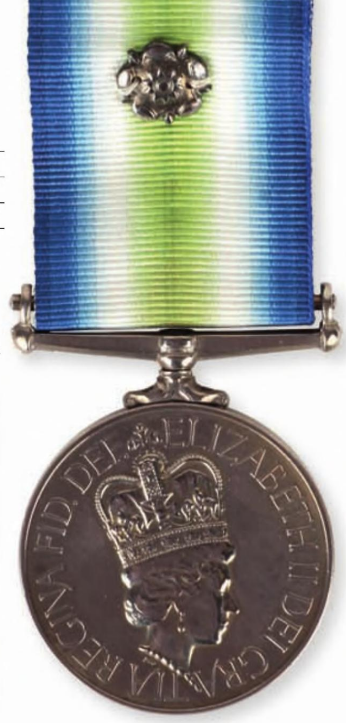
The first operational service medal to be designed and produced in Australia, this was awarded to members of the Australian and New Zealand armed forces who served in Vietnam between May 1964 and January 1973. The reverse shows a figure of a man standing between two spheres.

▼ KOSOVO NATO SERVICE MEDAL

Date 1999
Origin NATO
Conflict Kosovo War

This bronze medal bearing the NATO star emblem set in a wreath of olive leaves was first instituted to reward personnel who took part in operations during the Kosovo War (1998–99) in the former Yugoslavia, for 30 days continuous service inside the country.

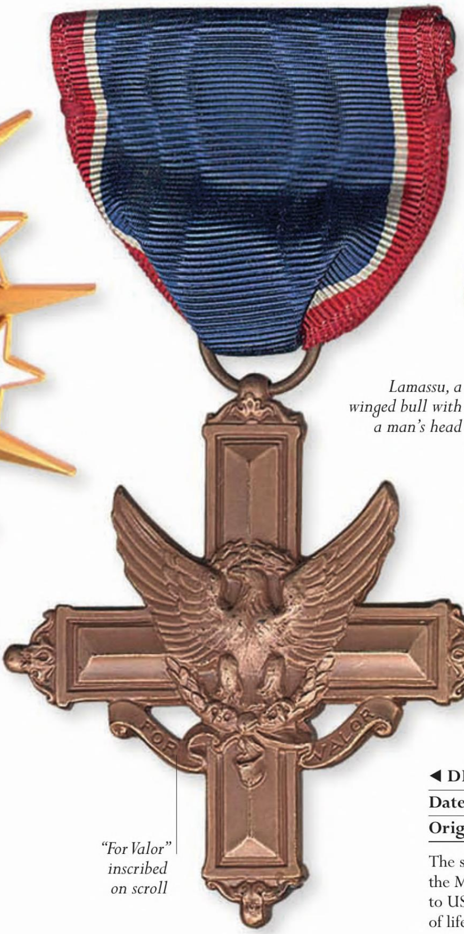




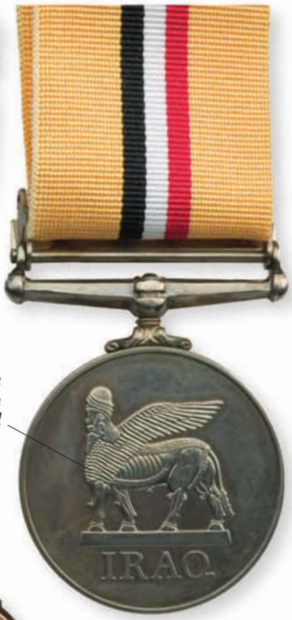
▲ SOUTH ATLANTIC MEDAL

Date 1982
Origin UK
Conflict Falklands War

The South Atlantic Medal was issued to all UK military personnel involved in the liberation of South Georgia and the Falkland Islands after Argentina's invasion in 1982. The coat of arms of the Falklands appears on the reverse. A rosette on the medal ribbon denotes service in the battle zone.



"For Valor" inscribed on scroll



Lamassu, a winged bull with a man's head

◀ IRAQ MEDAL

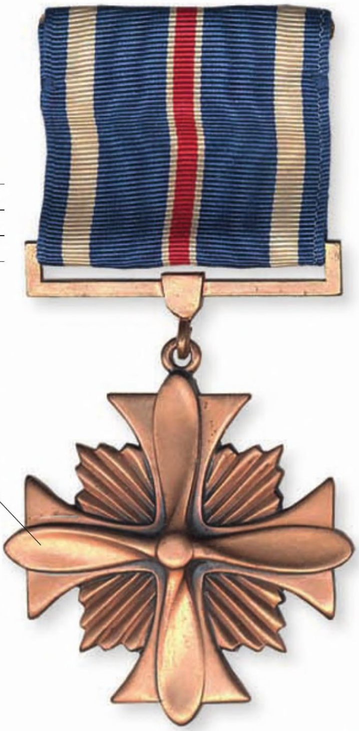
Date 2004
Origin UK
Conflict Iraq War

This award was given to all military and civilian participants in British actions in Iraq from 2003 to 2011, known as Operation Telic. Those who saw combat from 19 March 2003 were awarded a silver ribbon rosette. The reverse of the medal (shown) depicts a lamassu (a figure from Assyrian mythology).

◀ DISTINGUISHED SERVICE CROSS

Date 1918
Origin US

The second highest military decoration after the Medal of Honor, this medal is awarded to US forces for extreme gallantry and risk of life in actual combat. Just over 1,000 were issued in the Vietnam War – 400 of which were awarded posthumously.



Cross motif formed by four-bladed propeller

▶ DISTINGUISHED FLYING CROSS

Date 1927
Origin US

This bronze medal for air crew is given for "heroism or extraordinary achievement while participating in an aerial flight", and has been awarded in all the major US conflicts since its institution, most recently in Iraq and Afghanistan (see pp.436–37).

KEY DEVELOPMENT

THE CONTEMPORARY ERA

The most significant developments in recent military technology have been driven not by increased firepower, but by the integration of electronics and computers into weapons systems; many modern conflicts bear witness to the advantage these technologies can provide.

The first steps towards precision-guided ("smart") weapons date back to the final stages of World War II, but it was not until the late 20th century that these devices truly transformed the military environment. The combination of vast leaps in computer power with the miniaturization of electronics over recent decades has led to the development of projectiles with their own guidance systems, enabling exceptional accuracy over long ranges. This process has extended from the radar and heat-seeking guidance systems that are now commonplace in missiles, to some artillery shells, ground-launched rockets, and even man-portable projectile weapons.

Modern military aircraft are fitted with a huge array of electronics to improve missile accuracy and acquire targets alongside devices that help to counter anti-aircraft weapons. Remote-control guidance has been extended to the weapons themselves: the "drone", or Unmanned Aerial Vehicle (UAV), is one such example. This remote-controlled aircraft can fly over hostile territory to provide detailed photographic reconnaissance, or even conduct strike missions, without the risk of a pilot being killed or captured.

SOUND AND VISION

Battlefield communications have improved vastly over recent years. The "fog of war" – which prevented a general from knowing what was going on in battle – is mostly a thing of the past, with individual radios allowing officers and troops to communicate directly. Global Positioning Satellites (GPS) enable a commander back at base to maintain close control over patrols or armoured vehicles, with constant, real-time updates on their position and battlefield capability. For the troops on the frontline, laser range-finders improve the accuracy of weapons, and nightfall no

KEY **ATTACK**

AL-QAEDA ATTACKS AMERICA

11 SEPTEMBER 2001

The assault by al-Qaeda on the US homeland in 2001 exposed the inherent vulnerability of an open society to attack. The terrorists, armed only with knives, were able to hijack four civilian airliners, crashing two of them into the World Trade Center, and one into the Pentagon.

▲ The second aircraft crashes into the World Trade Center; 2,977 civilians died in the attacks that day.

▼ **AFGHANISTAN**
A US Army CH-47 Chinook helicopter provides aerial security in Khost Province, Afghanistan, in early 2012.

◄ **BAGHDAD, MARCH 2003**
This apocalyptic image shows Baghdad burning during the opening stages of the coalition assault. US electronic counter-measures suppressed Iraqi air-defences, leaving the city fatally vulnerable to attack.

longer brings military operations to a halt. Night-vision equipment was initially based on heavy, infra-red scopes, but improvements, including the arrival of light-intensifying starlight scopes, have made the 24-hour battlefield a reality.

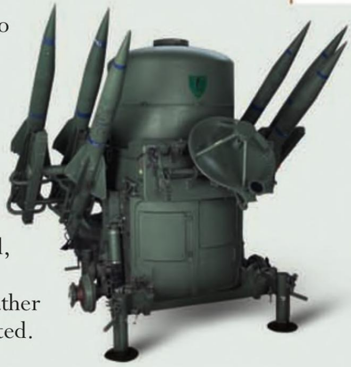
The 1991 Gulf War proved the value of these, when a US-led force using the latest battlefield technology suceeded in ejecting the army of Iraqi dictator Saddam Hussein from Kuwait with little difficulty. The importance of the US and coalition forces' advanced weapons was confirmed a few years later in the success of the well-coordinated 2003 invasion of Iraq, against a much less well-equipped Iraqi army. This mastery has given the armed forces of advanced nations – especially the US – a significant advantage over the less well-equipped conventional armies of other nations.

However, terrorists armed with the simplest weapons have still been able to wreak havoc in Western societies, for example in the attacks on the US in 2001. In Iraq, insurgent groups emerged from the ruins to wage a sustained war against occupying forces, and in Afghanistan, the materially superior US and its allies have been unable to defeat Taliban fighters. The latter use classic guerrilla tactics – striking at weak points before melting back into the civilian population, or using civilians as human shields during firefights. For all their advanced technology, the armies of the West have yet to overcome simply-armed, determined insurgents, some of whom would rather face death than be defeated.

KEY **EVENTS**

20TH–21ST CENTURY

- **September 1943** An air-launched radio-controlled German bomb ("Fritz-X") hits the Italian battleship *Roma*. This is the first use of a guided weapon in combat.
- **April–May 1972** US aircraft destroy the Thanh Hoa bridge in North Vietnam with laser-guided bombs; the bridge had survived 800 previous US sorties using conventional bombs.
- **1960s** The first night-vision devices are used, by US troops in the Vietnam conflict.
- **1991** Operation Desert Storm sees the first mass use of precision-guided munitions against military targets in Iraq, including laser-guided bombs (LGBs).
- **July 1995** The US Predator UAV enters service, and is seen by some military theorists as the future of air warfare in the 21st century.
- **2000s** Panoramic Night Vision Goggles (PNVGs) are developed and assigned to selected US aircrews, providing 95-degree vision.

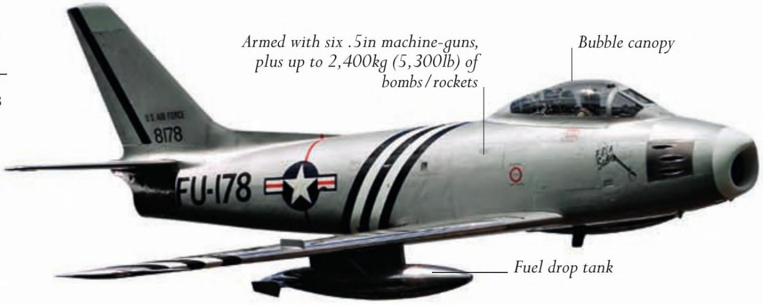


◄ **RAPIER SURFACE-TO-AIR MISSILE LAUNCHER**
The Rapier is noted for its accuracy and fast reaction time; it is used for ground-to-air defence by nine countries, including Switzerland, Turkey, and Iran. A mobile, tracked version is also in service.

> "Our troops will have **the best possible support in the entire world**, and they will not be asked to fight **with one hand tied behind their back**"
>
> **US PRESIDENT GEORGE BUSH SR.**, 1991

FIGHTER AND STRIKE AIRCRAFT

Fighter aircraft have been transformed since the first subsonic jets fought each other in the Korean War (1950–53). Today, they have the capacity to travel at over twice the speed of sound, and are also capable of carrying an enormous weight of missiles, rockets, and bombs – well in excess of the bomb loads carried by World War II heavy bombers such as the B17 (see pp.314–17). The most recent advances, however, have been made in the field of aviation electronics. The latest fly-by-wire (i.e. computerized) control systems allow a manoeuvrability that would be impossible using conventional mechanical or human means, while weapons can be guided towards their target with pinpoint accuracy.



Armed with six .5in machine-guns, plus up to 2,400kg (5,300lb) of bombs/rockets

Bubble canopy

Fuel drop tank

▲ NORTH AMERICAN F-86 SABRE

Date 1949 **Origin** US

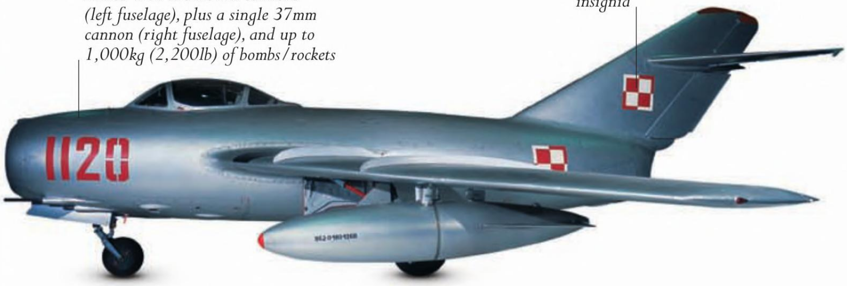
Wingspan 11.93m (39¼ft)

Length 11.84m (38¾ft)

Top speed 1,114kph (692mph)

Engine 26.3kN (5,910lb) General Electric J73-GE-3D

The first swept-wing fighter in the US Air Force, the F-86 was also a highly successful fighter that was able to take on the MiG-15. Including all variants, over 9,000 F-86s were built – more than any other Western jet fighter.



Armed with two 23mm cannons (left fuselage), plus a single 37mm cannon (right fuselage), and up to 1,000kg (2,200lb) of bombs/rockets

Polish aviation insignia

▲ MIKOYAN-GUREVICH MIG-15

Date 1949 **Origin** Soviet Union

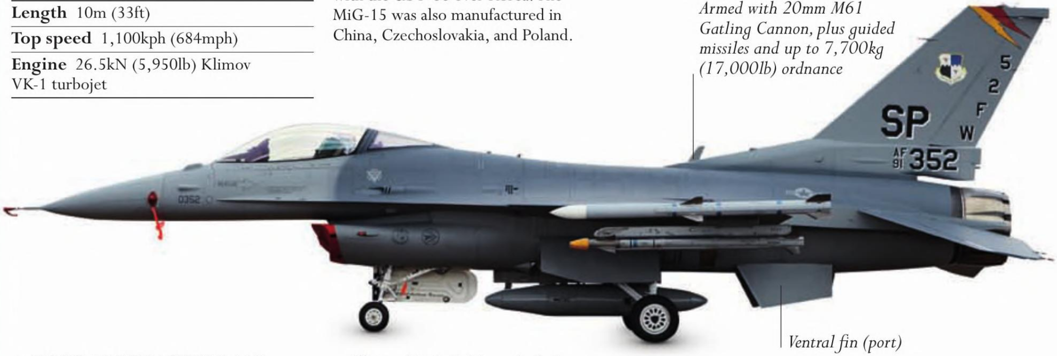
Wingspan 10.08m (33ft)

Length 10m (33ft)

Top speed 1,100kph (684mph)

Engine 26.5kN (5,950lb) Klimov VK-1 turbojet

The Soviet Union broke new ground with this advanced fighter that saw the first ever jet combat with the US F-86 over Korea. The MiG-15 was also manufactured in China, Czechoslovakia, and Poland.



Armed with 20mm M61 Gatling Cannon, plus guided missiles and up to 7,700kg (17,000lb) ordnance

Ventral fin (port)

▲ GENERAL DYNAMICS F-16C FIGHTING FALCON

Date 1978 **Origin** US

Wingspan 9.96m (32¾ft)

Length 15.06m (49½ft)

Top speed 2,410kph (1,500mph)

Engine 76.3kN (17,155lb) F110-GE-100 turbofan

The multirole F-16 was built in response to the US Air Force's demand for a lightweight fighter. One of the first aircraft to use fly-by-wire controls, it was fast and extremely manoeuvrable.

Inflight refuelling probe

Variable exhaust nozzle

▼ BAE HARRIER II GR9A

Date 1989 **Origin** UK

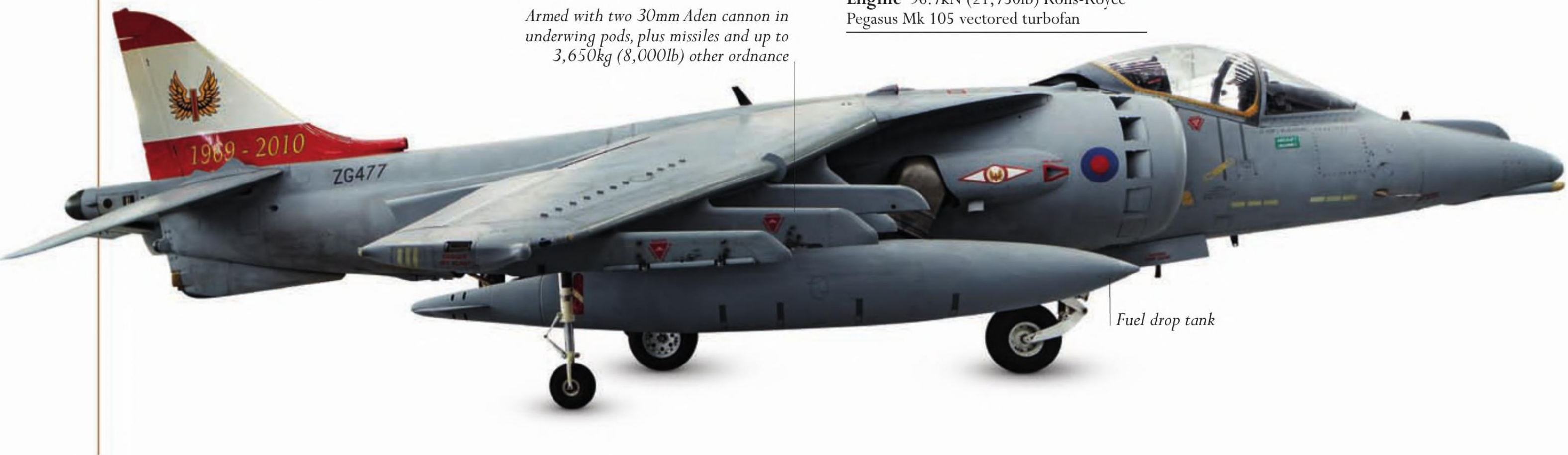
Wingspan 9.25m (30⅓ft)

Length 14.12m (46⅓ft)

Top speed 1,065kph (662mph)

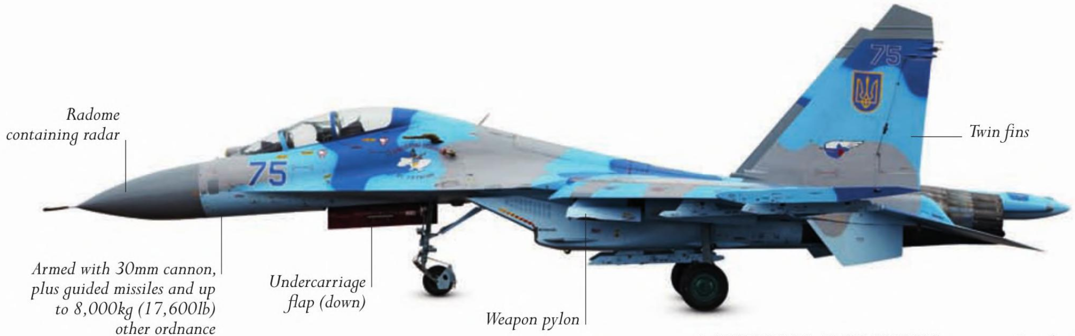
Engine 96.7kN (21,750lb) Rolls-Royce Pegasus Mk 105 vectored turbofan

The most advanced of all the Harriers, a series that began in 1969, the GR9A is a Vertical/Short Take-off and Landing (V/STOL) jet aircraft. This model is primarily used as a light strike aircraft.



Armed with two 30mm Aden cannon in underwing pods, plus missiles and up to 3,650kg (8,000lb) other ordnance

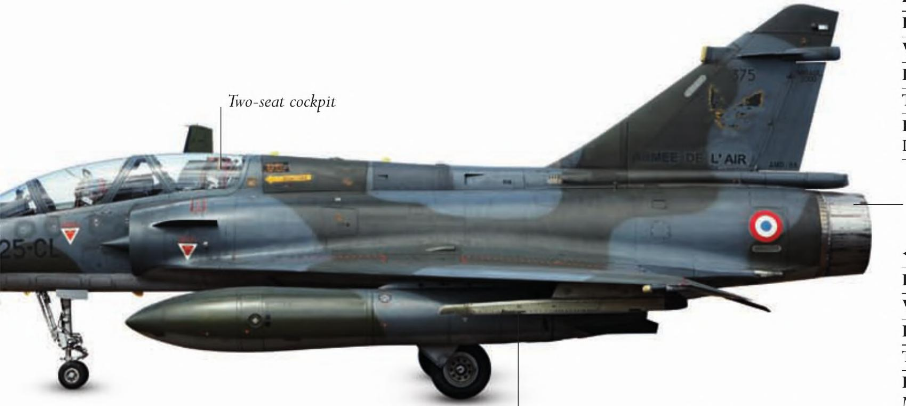
Fuel drop tank


Radome containing radar
Twin fins
Armed with 30mm cannon, plus guided missiles and up to 8,000kg (17,600lb) other ordnance
Undercarriage flap (down)
Weapon pylon

▲ SUKHOI SU-27 "FLANKER"

Date 1984 **Origin** Soviet Union
Wingspan 14.7m (48¼ft)
Length 21.9m (72ft)
Top speed 2,500kph (1,550mph)
Engine Two 75.22kN (16,910lb) Saturn/Lyulka AL-31F turbofans

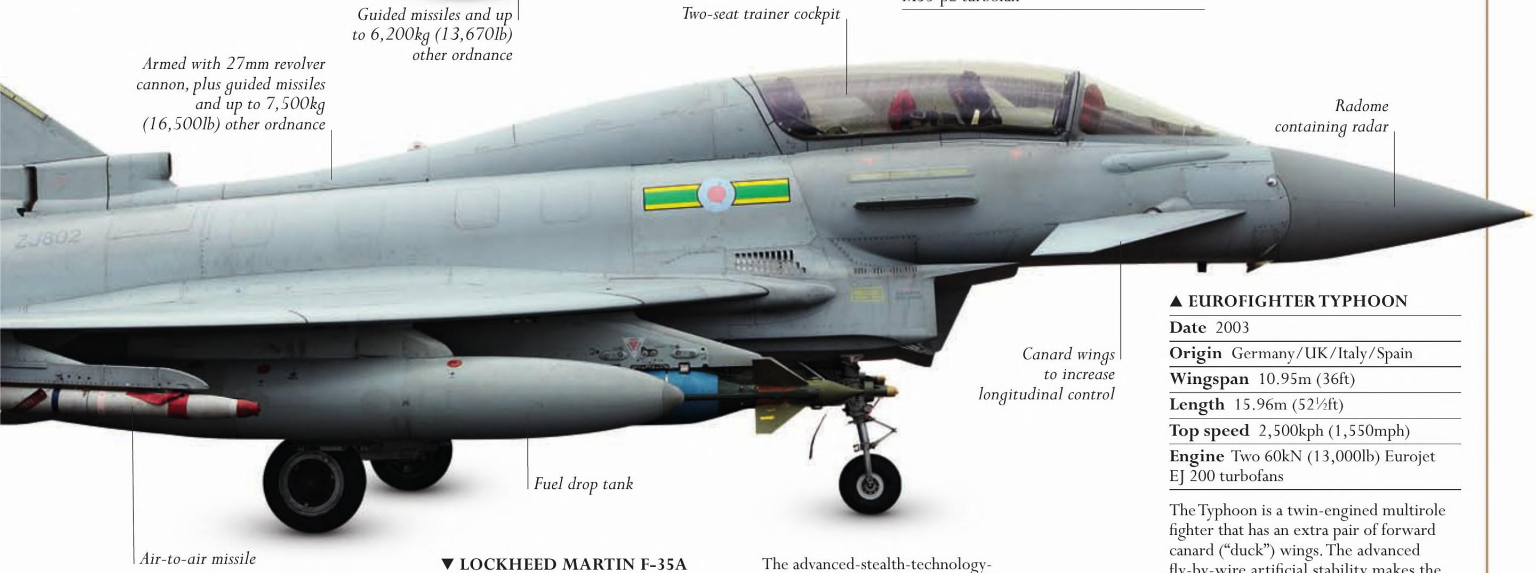
Developed in response to the American F-15, the Su-27 is a large twin-engined multirole aircraft employing advanced avionics. In order to minimize weight, large sections of the Su-27 have been built from titanium.


Two-seat cockpit
Variable exhaust nozzle
Guided missiles and up to 6,200kg (13,670lb) other ordnance

◀ DASSAULT MIRAGE 2000D

Date 1995 **Origin** France
Wingspan 9.13m (30ft)
Length 14.55m (47¾ft)
Top speed 2,338kph (1,453mph)
Engine 64.3kN (14,500lb) SNECMA M53-p2 turbofan

The 2000D is the conventional strike aircraft counterpart of the nuclear-armed 2000N. The single-engined 2000D employs advanced avionics and has seen active service over the former Yugoslavia, Afghanistan, and Libya.


Armed with 27mm revolver cannon, plus guided missiles and up to 7,500kg (16,500lb) other ordnance
Two-seat trainer cockpit
Radome containing radar
Canard wings to increase longitudinal control
Fuel drop tank
Air-to-air missile

▲ EUROFIGHTER TYPHOON

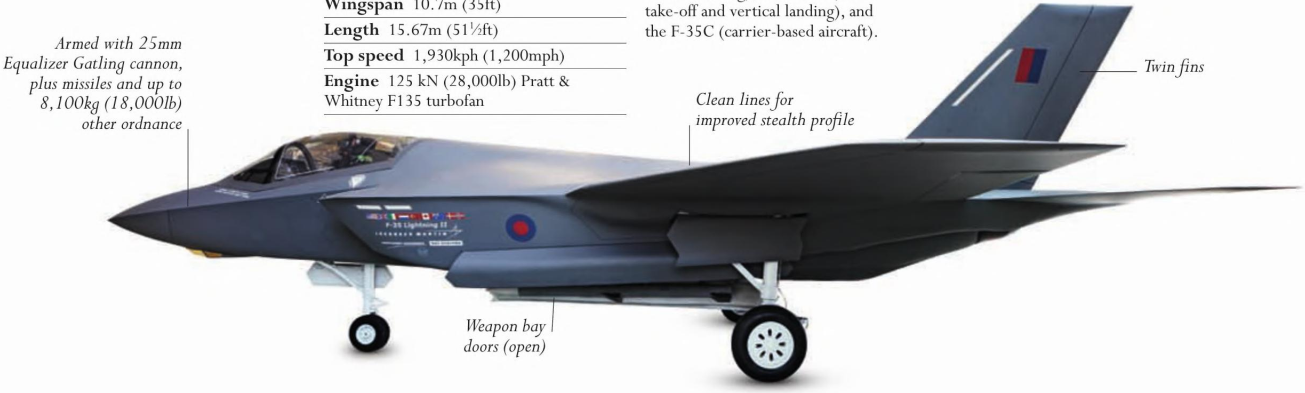
Date 2003
Origin Germany/UK/Italy/Spain
Wingspan 10.95m (36ft)
Length 15.96m (52½ft)
Top speed 2,500kph (1,550mph)
Engine Two 60kN (13,000lb) Eurojet EJ 200 turbofans

The Typhoon is a twin-engined multirole fighter that has an extra pair of forward canard ("duck") wings. The advanced fly-by-wire artificial stability makes the aircraft exceptionally easy to manoeuvre.

▼ LOCKHEED MARTIN F-35A LIGHTNING II

Date 2006 **Origin** US
Wingspan 10.7m (35ft)
Length 15.67m (51½ft)
Top speed 1,930kph (1,200mph)
Engine 125 kN (28,000lb) Pratt & Whitney F135 turbofan

The advanced-stealth-technology-equipped F-35 comes in three different models: the F-35A (conventional take-off and landing); the F-35B (short take-off and vertical landing), and the F-35C (carrier-based aircraft).


Armed with 25mm Equalizer Gatling cannon, plus missiles and up to 8,100kg (18,000lb) other ordnance
Twin fins
Clean lines for improved stealth profile
Weapon bay doors (open)

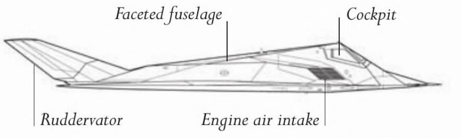
STEALTH GROUND-ATTACK AIRCRAFT

LOCKHEED F-117 NIGHTHAWK

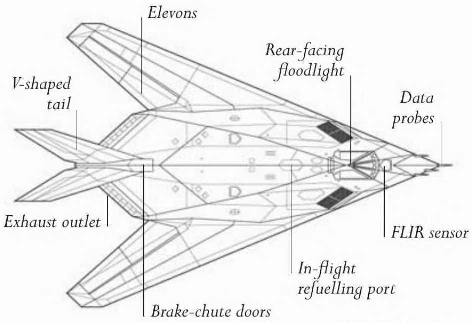
The first operational aircraft designed around stealth technology, the F-117 used faceting – sharply angled surfaces – to reduce its radar signature, enabling it to strike undetected at heavily defended targets.

The F-117 was a direct descendant of Have Blue, an experimental stealth aircraft that Lockheed began developing in 1975. The USAF received its first F-117s in 1982, but the plane's existence remained a secret until 1988. Despite its F (fighter) designation, the Nighthawk was a ground-attack aircraft. It typically carried a pair of 910kg (2,000lb) laser-guided bombs in its internal weapons bay, but had no air-to-air capability. During the Gulf War of 1991, F-117s carried out more than 40 per cent of all strategic air strikes. The aircraft was retired in 2008.

Stealth technology gave the F-117 a radar signature equivalent to that of a small bird. Its angled surfaces scattered incoming radar waves instead of reflecting them back at their source, and a coating of matt-black radar-absorbent material (RAM) further reduced the signature. To avoid detection the aircraft could not use radar itself, so navigation was by GPS and an inertial guidance system. Efforts to conceal the Nighthawk from heat-seeking missiles included dispensing with afterburners on the engines and cooling the exhaust by channelling it through long ducts lined with heat-absorbent material.



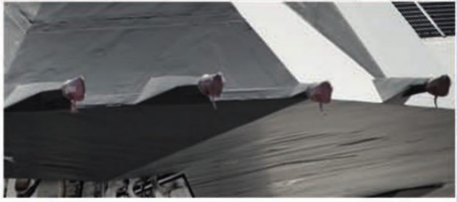
SIDE VIEW



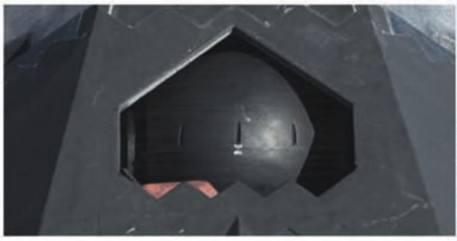
PLAN VIEW

▲ **LOCKHEED F-117 NIGHTHAWK**
Nearly 20.1m (66ft) long and with a wingspan of 13.2m (43⅓ft), the F-117 was powered by two General Electric F404 non-afterburning turbofans.

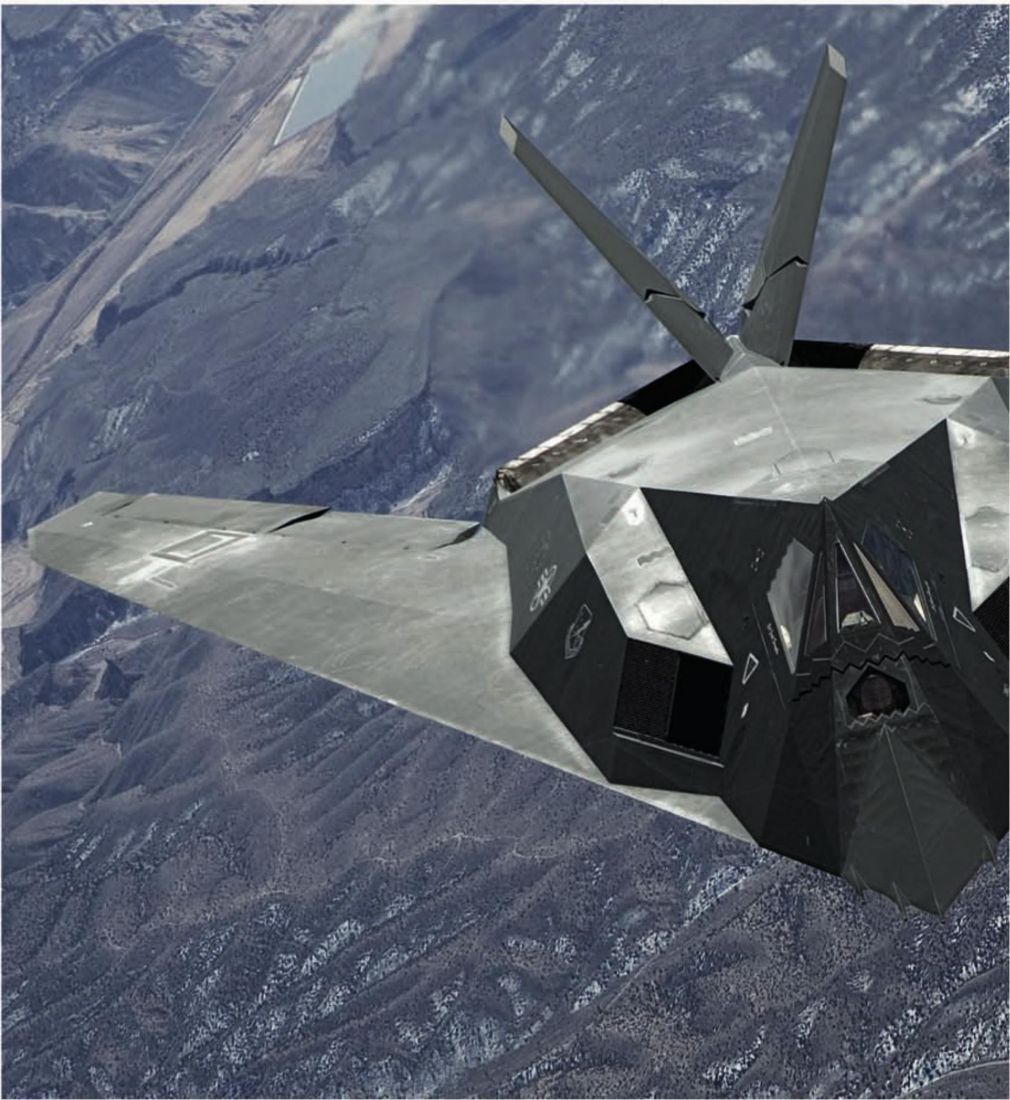
DATA SENSORS



▲ **DATA PROBES**
Projecting from the tip of the Nighthawk's nose were four short probes that collected data on the aircraft's airspeed and angle of attack.

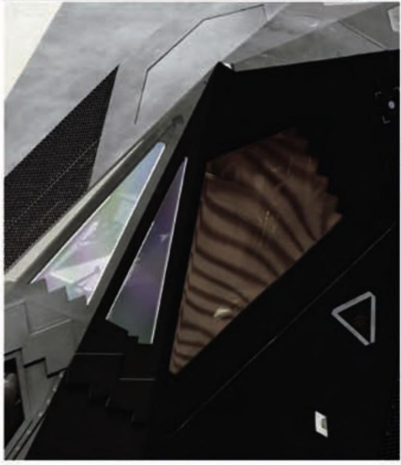


▲ **INFRARED SENSOR**
The Forward-Looking Infrared Sensor (FLIR) was used to locate targets. There was also a downward-looking sensor (DLIR) by the front undercarriage.

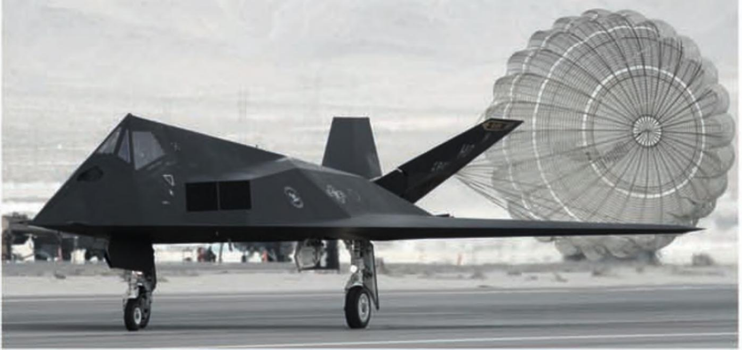


▶ **IN FLIGHT**
Stealth affected flying abilities: the F-117 was limited to subsonic speeds, and its shape made it unstable. Known as the "Wobblin' Goblin", it could be flown only with a computer-controlled fly-by-wire system.

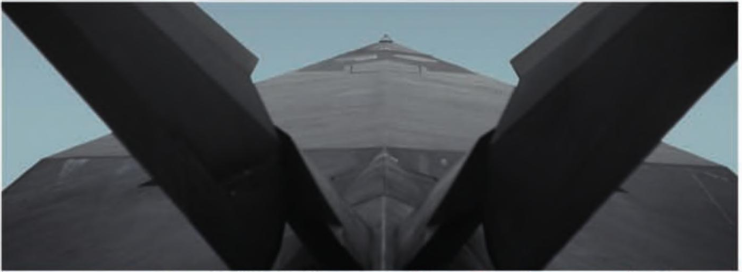
FUSELAGE AND WINGS



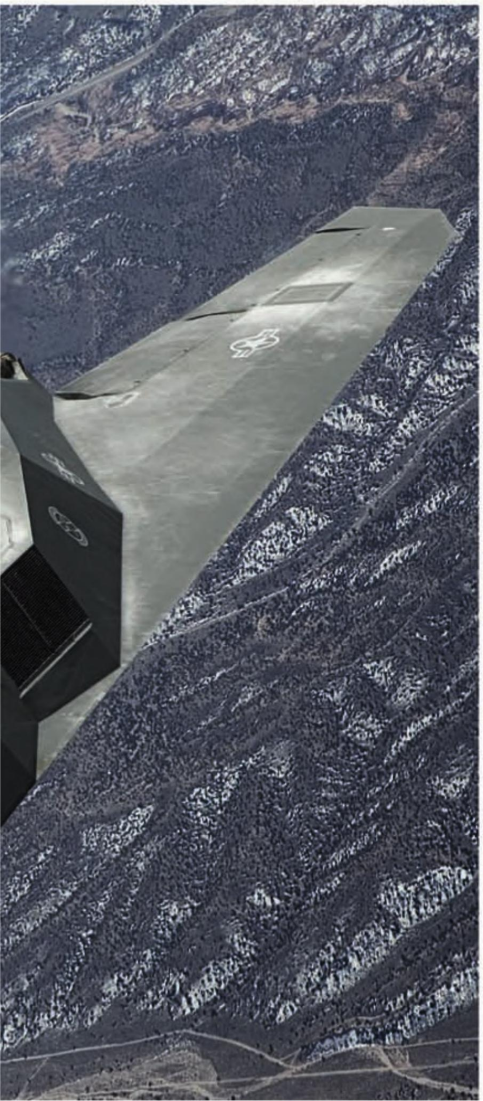
▲ ANGULAR WINDOWS The windows had a thin gold coating to absorb radar energy into the airframe. Dogtooth patterns along window and canopy edges, and on other openings and panels, helped to disrupt radar reflections.

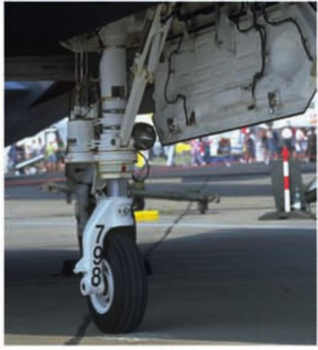


◄ PARACHUTE The wings possessed elevons but no flaps, so the landing speed was quite high. A brake-chute was used to reduce the length of the landing run.

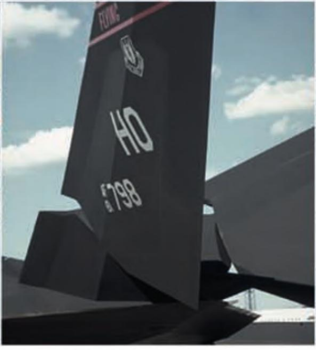


◄ FORWARD VIEW FROM TAIL At night, a rear-facing floodlight on top of the canopy illuminated the in-flight refuelling port (the central panel just below the light). Brake-chute doors were located at the base of the ruddervators.

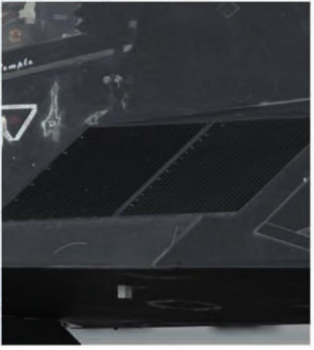




▲ FRONT WHEEL The F-117 "borrowed" parts from other existing planes: the front undercarriage, for example, was taken from the Lockheed A-10 Thunderbolt.

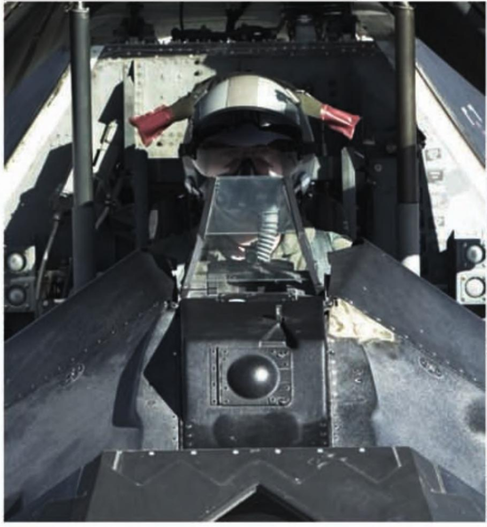


▲ V-SHAPED TAIL Sometimes referred to as "ruddervators", the two forks of the tail combined the functions of rudders and elevators.

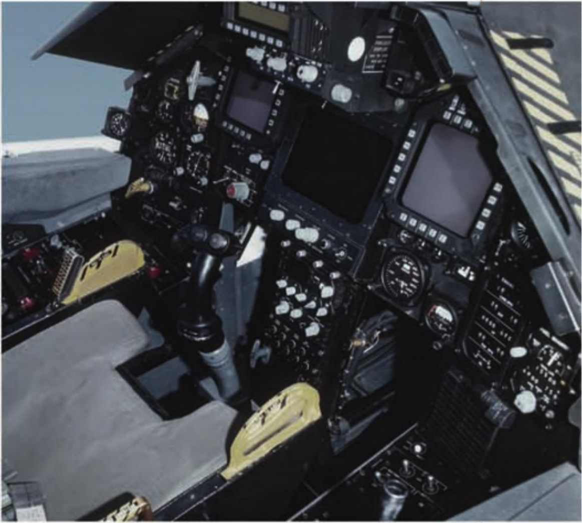


▲ INTAKE GRILLES Fine-mesh grilles over the engine air intakes prevented radar from reflecting off the compressor blades.

INSIDE THE COCKPIT



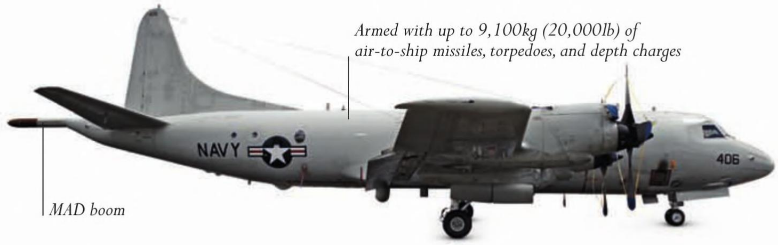
▲ HEAD-UP DISPLAY Located on top of the instrument decking, the head-up display (HUD) projected key information onto the pilot's forward view through the windscreen.



▲ INSTRUMENT DECKING The F-117's cockpit included a central screen for infrared imagery, twin multi-function colour displays for flight and weapons data, and a digital moving-map system.

ELECTRONIC WARFARE AND RECONNAISSANCE AIRCRAFT

Aerial reconnaissance plays a vital role in intelligence gathering, whether at a tactical level via the MiG-21 and OV-1 Mohawk, or at a strategic level via the U-2 or SR-71. These "eyes in the sky" reached a new level of sophistication with the introduction of Airborne Early Warning (AEW) aircraft, which can build up an electronic picture of enemy movements from enormous distances. These in turn have evolved into Airborne Warning and Control System (AWACS) aircraft, which provide all-weather command, communications, and surveillance.


Armed with up to 9,100kg (20,000lb) of air-to-ship missiles, torpedoes, and depth charges
MAD boom
NAVY
406

▲ LOCKHEED P-3C ORION

Date 1962 **Origin** US

Wingspan 30.4m (99¾ft)

Length 35.6m (116¾ft)

Top speed 750kph (466mph)

Engine Four 3,700kW (4,600hp) Allison T56-A-14 turboprops

Developed from the Electra commercial airliner, the Orion acts as a maritime surveillance and anti-submarine aircraft. Its Magnetic Anomaly Detector (MAD) boom is used to track the presence of submerged submarines.

Pilot tube to determine air speed

▶ LOCKHEED U-2

Date 1957 **Origin** US

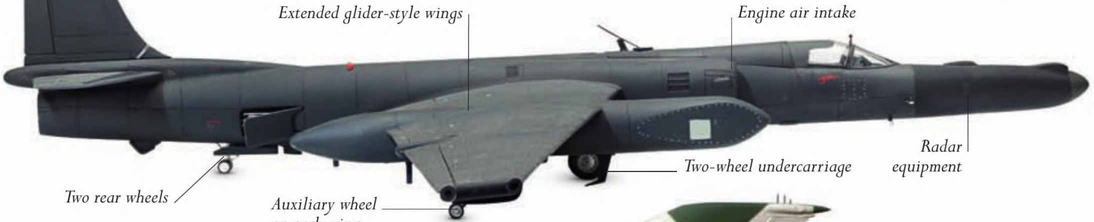
Wingspan 31.4m (103ft)

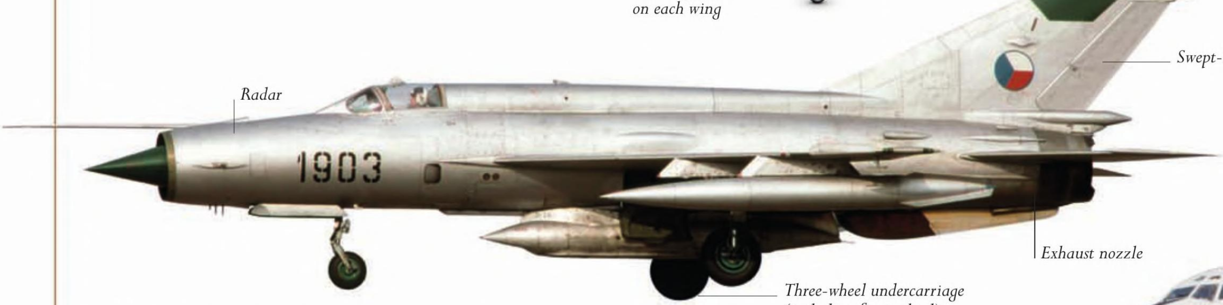
Length 19.2m (63ft)

Top speed 805kph (500mph)

Engine 8,618kg (19,000lb) General Electric F118-101 turbofan

A strategic reconnaissance aircraft, the U-2 – capable of cruising at heights of 21,000m (70,000ft) – was used by the Central Intelligence Agency (CIA) as a spy plane. It earned infamy when one was shot down in Soviet airspace in 1960.


Fin
01075
Extended glider-style wings
Engine air intake
Two-wheel undercarriage
Radar equipment
Two rear wheels
Auxiliary wheel on each wing


Swept-back fin
Radar
1903
Exhaust nozzle
Three-wheel undercarriage (including front wheel)

▲ MIKOYAN-GUREVICH MIG-21R

Date 1959 **Origin** Soviet Union

Wingspan 7.15m (23½ft)

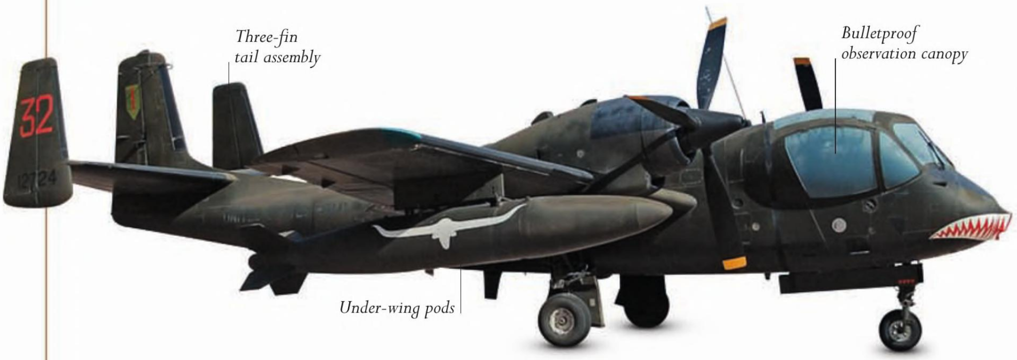
Length 15.76m (51¾ft)

Top speed 2,230kph (1,385mph)

Engine 6,600kg (14,550lb) Tumansky R-13-300 turbojet

One of the most prolific aircraft in the Soviet armoury, the MiG-21R was a tactical reconnaissance variant in which guns were replaced by optical and infrared cameras, either mounted within the airframe or in external wing pods.

Chin bulge with Electronic Surveillance Measures (ESM) suite


Three-fin tail assembly
32
Bulletproof observation canopy
Under-wing pods

◀ GRUMMAN OV-1 MOHAWK

Date 1959 **Origin** US

Wingspan 14.63m (48ft)

Length 12.5m (41ft)

Top speed 724kph (450mph)

Engine Two 1,044kW (1,400hp) Lycoming T53-L-701 turboprops

Designed for battlefield surveillance, the Mohawk was fitted with optical cameras and a Side-Looking Airborne Radar (SLAR) that provided a detailed picture of enemy movements on the ground.

▶ GRUMMAN E-2C HAWKEYE

Date 1964 **Origin** US

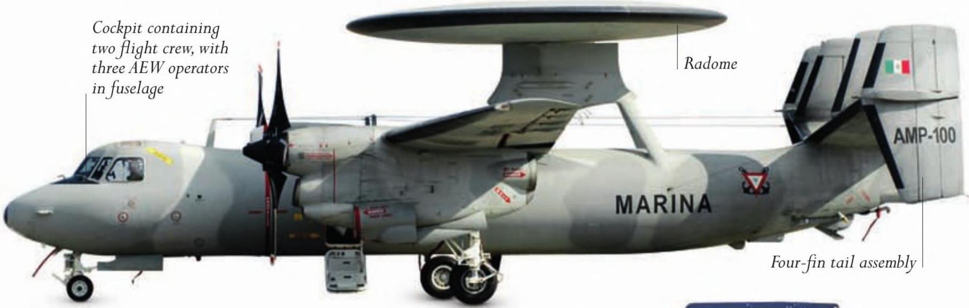
Wingspan 24.56m (80½ft)

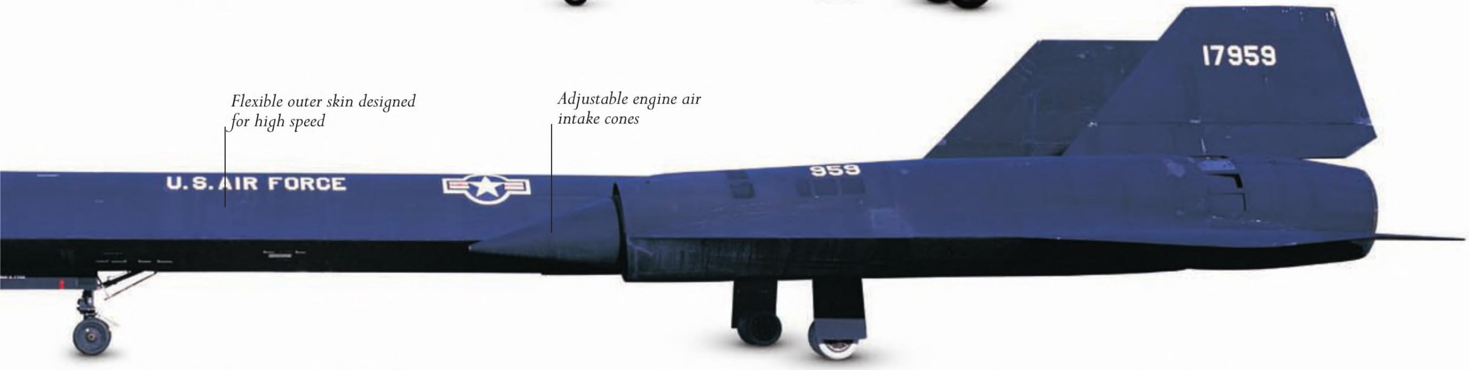
Length 17.54m (57½ft)

Top speed 602kph (374mph)

Engine Two 3,663kW (4,910hp) Allison T56-A-425 turboprops

The first true Airborne Early Warning (AEW) aircraft, the Hawkeye's distinctive rotating radome was able to discover and track enemy aircraft, and then direct friendly aircraft to intercept them.


Cockpit containing two flight crew, with three AEW operators in fuselage
Radome
Four-fin tail assembly
AMP-100
MARINA


Flexible outer skin designed for high speed
Adjustable engine air intake cones
U.S. AIR FORCE
959
17959

▲ LOCKHEED SR-71 BLACKBIRD

Date 1966 **Origin** US

Wingspan 16.94m (55½ft)

Length 32.74m (107½ft)

Top speed 3,661kph (2,275mph)

Engine Two 14,742kg (32,500lb) Pratt & Whitney J58-1 turbo ramjets

A strategic reconnaissance aircraft that saw extensive operational service during the Vietnam War, the SR-71 is not only the world's fastest aircraft, it has also set the sustained altitude record of 29,929m (98,192ft).

▼ BOEING E-3A SENTRY (AWACS)

Date 1977 **Origin** US

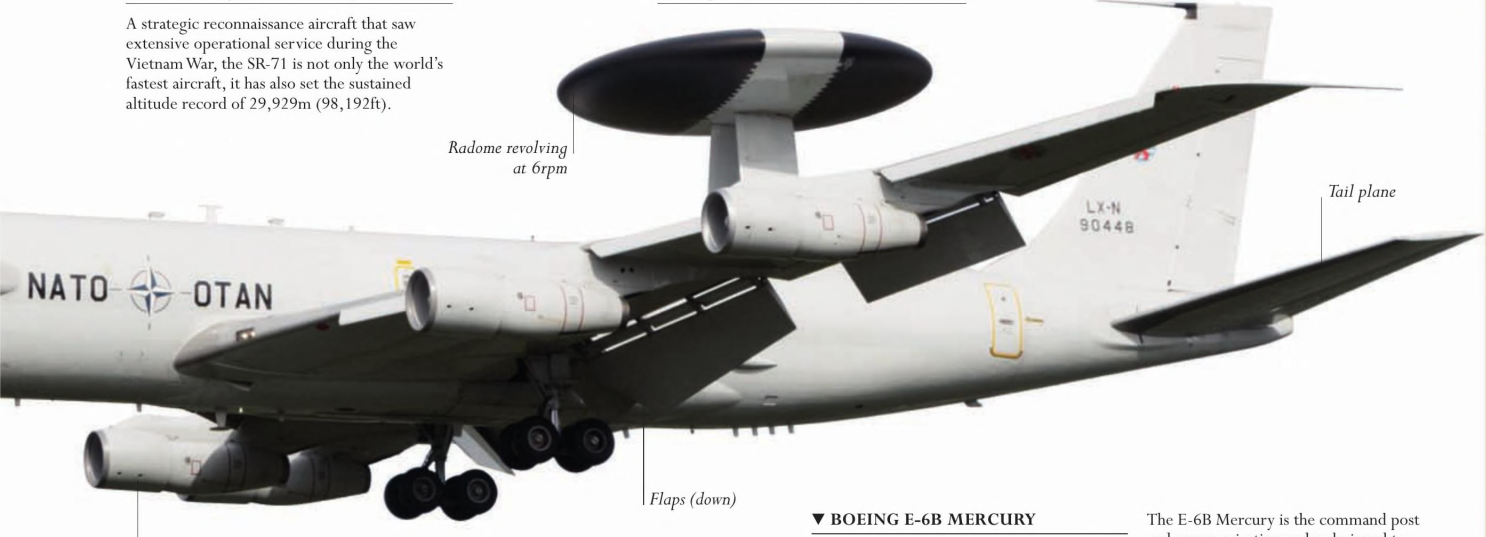
Wingspan 44.4m (145¼ft)

Length 46.6m (153ft)

Top speed 853kph (530mph)

Engine Four 9,540kg (21,000lb) Pratt & Whitney TF33-PW-100 turbofans

The US Air Force's Airborne Warning and Control System (AWACS) is a converted Boeing 707 airliner. The rotating dish antenna can detect aircraft within a radius of 395km (245 miles). Onboard computers assess the threat and control friendly aircraft in defence.


Radome revolving at 6rpm
Tail plane
Flaps (down)
Pratt & Whitney turbojet
NATO OTAN
LX-N 90448

▼ BOEING E-6B MERCURY

Date 1989 **Origin** US

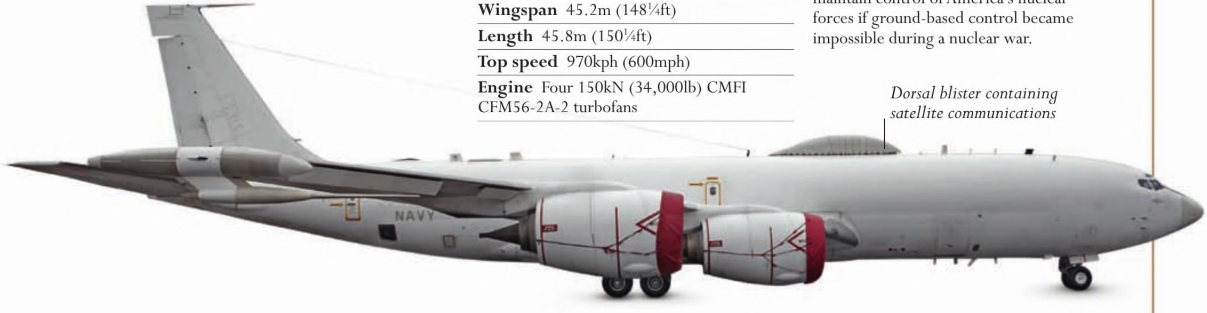
Wingspan 45.2m (148¼ft)

Length 45.8m (150¼ft)

Top speed 970kph (600mph)

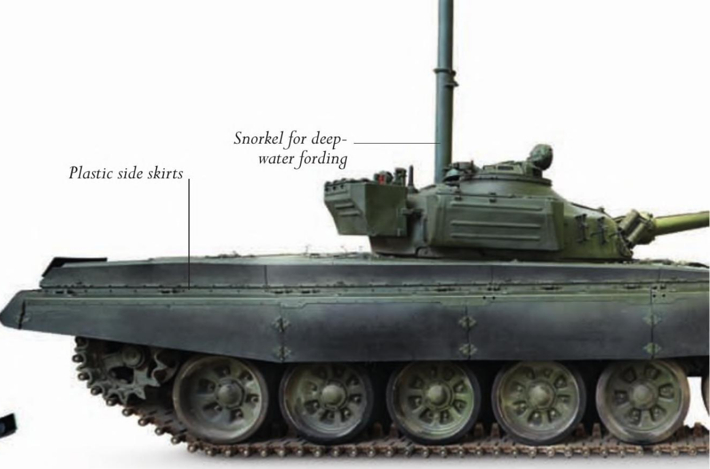
Engine Four 150kN (34,000lb) CMFI CFM56-2A-2 turbofans

The E-6B Mercury is the command post and communications relay designed to maintain control of America's nuclear forces if ground-based control became impossible during a nuclear war.


Dorsal blister containing satellite communications
NAVY

POST-WAR TANKS

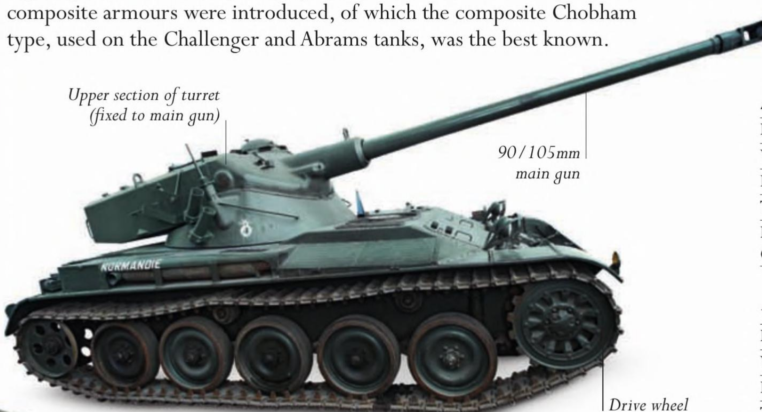
After 1945, a new class of armoured fighting tank or vehicle evolved: the Main Battle Tank (MBT), which was more heavily armoured, had a more powerful engine, and was armed with a more potent gun than its World War II predecessors. Although light and medium tanks were still manufactured, it was the MBT that dominated tank production and tactics. The major design development in this period was the introduction of new armour types. Conventional steel armour had become vulnerable to high-explosive anti-tank (HEAT) projectiles, and, to solve this problem, composite armours were introduced, of which the composite Chobham type, used on the Challenger and Abrams tanks, was the best known.


Snorkel for deep-water fording
Plastic side skirts

▲ T72

Date 1971 **Origin** Soviet Union
Weight 41.5 tonnes (45.7 tons)
Length 6.95m (22¾ft)
Top speed 60kph (37mph)
Engine 12-cylinder 582kW (780hp) diesel engine

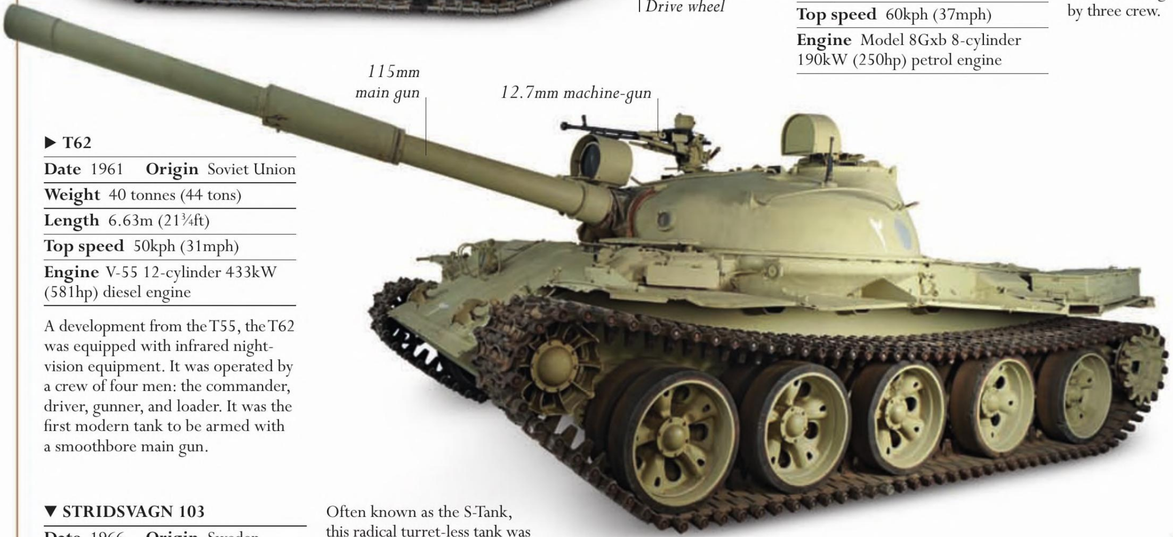
The three-man T72 was an effective, if not particularly advanced, tank that dispensed with the usual fourth crew member in favour of an automatic loader. It was widely exported to countries around the world.


Upper section of turret (fixed to main gun)
90/105mm main gun
NORMANDIE
Drive wheel

◀ AMX-13

Date 1952 **Origin** France
Weight 14.5 tonnes (15.9 tons)
Length 4.88m (16ft)
Top speed 60kph (37mph)
Engine Model 8Gxb 8-cylinder 190kW (250hp) petrol engine

Developed as an air-portable light tank to support airborne forces, the AMX-13 featured an unusual two-part turret and an automatic loading system with two six-round magazines. It was manned by three crew.


115mm main gun
12.7mm machine-gun

▶ T62

Date 1961 **Origin** Soviet Union
Weight 40 tonnes (44 tons)
Length 6.63m (21¾ft)
Top speed 50kph (31mph)
Engine V-55 12-cylinder 433kW (581hp) diesel engine

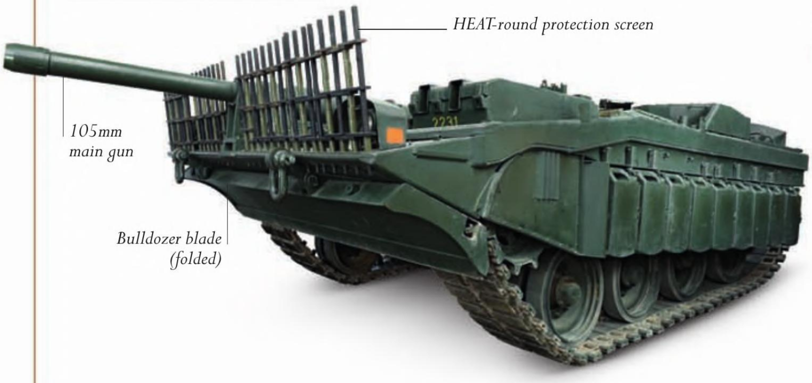
A development from the T55, the T62 was equipped with infrared night-vision equipment. It was operated by a crew of four men: the commander, driver, gunner, and loader. It was the first modern tank to be armed with a smoothbore main gun.

Reactive armour

▼ STRIDSVAGN 103

Date 1966 **Origin** Sweden
Weight 39 tonnes (42.9 tons)
Length 9m (29½ft)
Top speed 50kph (31mph)
Engine Rolls-Royce 223kW (490hp) diesel/Caterpillar gas turbine engine

Often known as the S-Tank, this radical turret-less tank was armed with a fixed gun that was traversed by engaging the left or right tracks, and elevated by adjusting the hull suspension. It was operated by three crew.


HEAT-round protection screen
105mm main gun
Bulldozer blade (folded)

▶ CHALLENGER 1 MBT

Date 1983 **Origin** UK

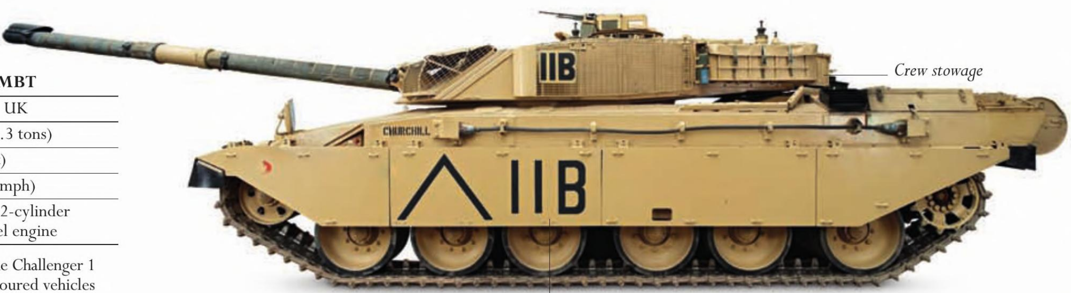
Weight 62 tonnes (68.3 tons)

Length 11.5m (37¾ft)

Top speed 56kph (35mph)

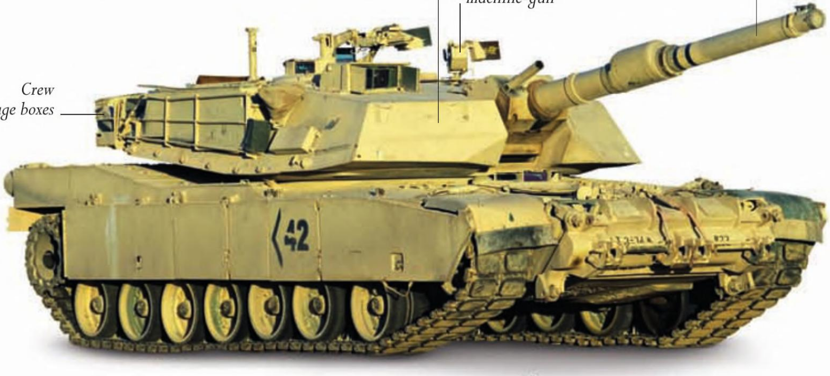
Engine Rolls-Royce 12-cylinder 895kW (1,200hp) diesel engine

Manned by four crew, the Challenger 1 was one of the first armoured vehicles to use Chobham ceramic composite armour. It was a considerable improvement over the underpowered Chieftain tank, and has now been superseded by the Challenger 2.



Crew stowage

Side skirts



Flat-sided Chobham armour

7.62mm machine-gun

120mm main gun

Crew stowage boxes

◀ M1A1 ABRAMS MBT

Date 1986 **Origin** US

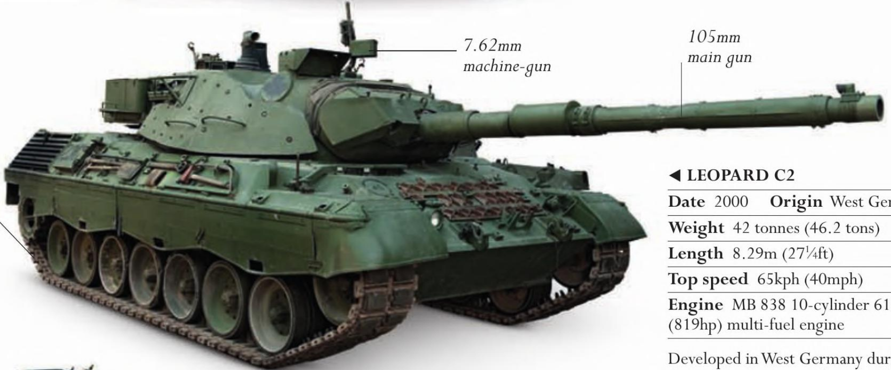
Weight 61.3 tonnes (67.5 tons)

Length 7.93m (26ft)

Top speed 67kph (42mph)

Engine Honeywell 1,120kW (1,500hp) multi-fuel turbine engine

The four-man M1A1 has become the US Army's MBT, seeing service in the 1991 Gulf War and the 2003 invasion of Iraq. Its main armament has been uprated from the M1's 105mm gun, and it features a gas-turbine engine.



7.62mm machine-gun

105mm main gun

Caterpillar tracks with rubber blocks for road use

◀ LEOPARD C2

Date 2000 **Origin** West Germany

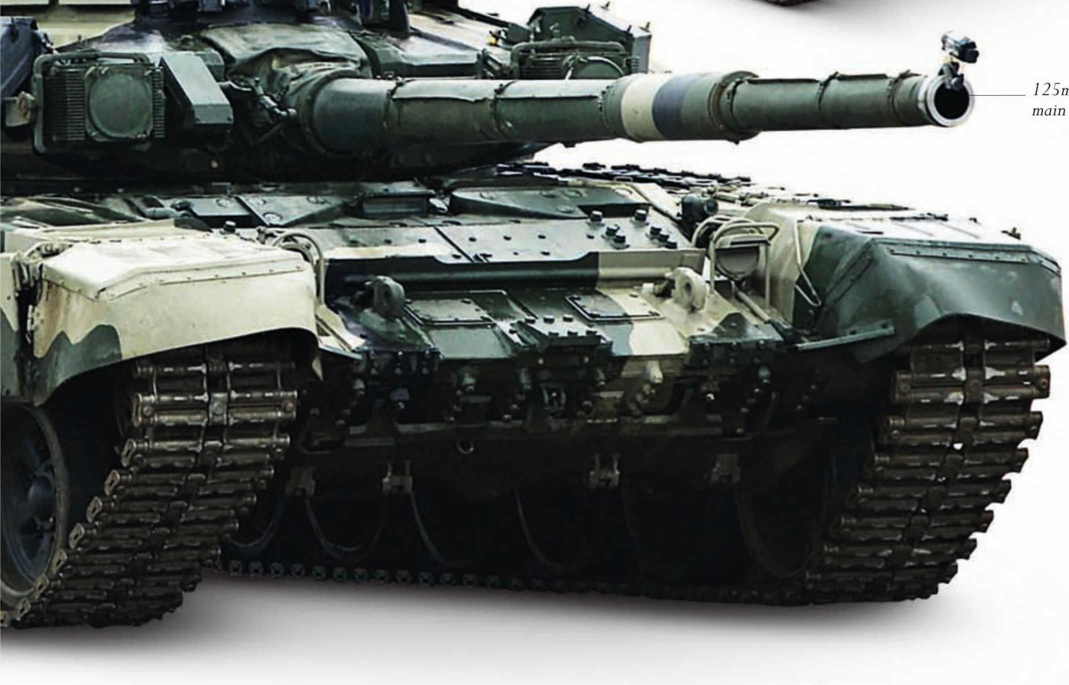
Weight 42 tonnes (46.2 tons)

Length 8.29m (27¼ft)

Top speed 65kph (40mph)

Engine MB 838 10-cylinder 610kW (819hp) multi-fuel engine

Developed in West Germany during the 1960s, the Leopard 1 proved to be a highly effective MBT. Several models were created for export, such as the improved C2 version that was adopted by the Canadian Army, among others.



12.7mm anti-aircraft gun

125mm main gun

◀ T90 MBT

Date 1993 **Origin** Russia

Weight 47.5 tonnes (52.3 tons)

Length 9.63m (31½ft)

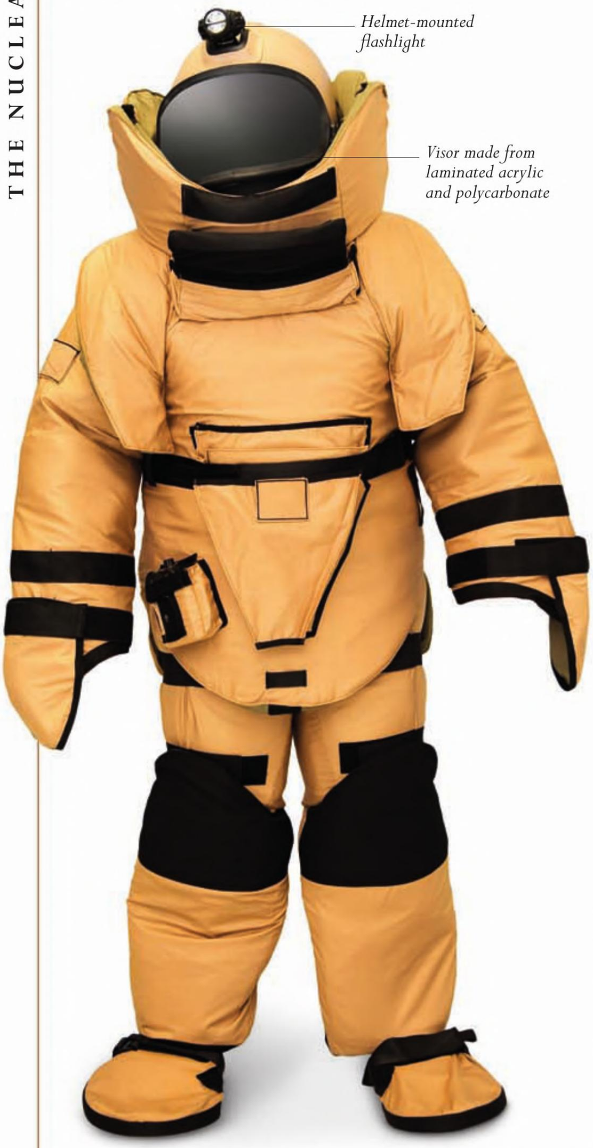
Top speed 65kph (40mph)

Engine V-84 12-cylinder 618kW (840hp) diesel engine

An evolutionary design based on the T72, the three-man T90 is the Russian army's MBT. It includes a new main gun, an increased array of electronic devices, and greatly improved armour protection.

INFANTRY UNIFORMS AND EQUIPMENT

The latter part of the 20th century saw the widespread introduction of body armour as part of the basic infantry kit in the armies of all developed countries. New synthetic materials, such as Kevlar and Spectra, were used to make vests that could protect against small-arms fire; plates made from ceramic or composite materials could be fitted into special pockets in the vests to protect vulnerable areas of the body against high-velocity rounds. Cutting-edge technology also shaped the development of uniforms, which incorporated flame-retardant and even anti-malarial elements.


Helmet-mounted flashlight
Visor made from laminated acrylic and polycarbonate

▲ ADVANCED BOMB SUIT

Date 1990s

Origin UK

Material Nomex, Kevlar, foam, armoured plates

Bomb suits are constructed from many layers of armoured material, since they are meant to protect against both explosive fragments and a bomb's blast wave. To minimize body heat, they are also fitted with their own cooling system.

▶ MK 6 HELMET

Date 1986

Origin UK

Material Ballistic nylon

This helmet was developed for the British Army to improve protection and to be worn in a variety of environments, including inside armoured vehicles.

▶ DESERT CAMOUFLAGE UNIFORM

Date 1990

Origin UK

Material Cotton, nylon

Designed for the conditions encountered in Iraq and Afghanistan, this two-colour Disruptive Pattern Material (DPM) desert uniform combines effective camouflage with a material adapted for use in high temperatures.

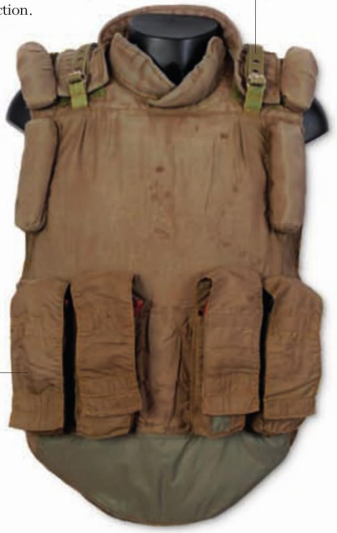
▼ 6B5 BODY ARMOUR

Date 1986

Origin Soviet Union

Material Nylon, Kevlar, titanium/ceramic plates

Used extensively during the conflict in Chechnya in the 1990s, 6B5 body armour was made of Kevlar sheets, with inserts of either ceramic or titanium to provide extra ballistic protection.



▼ DESERT BOOTS

Date 1990s

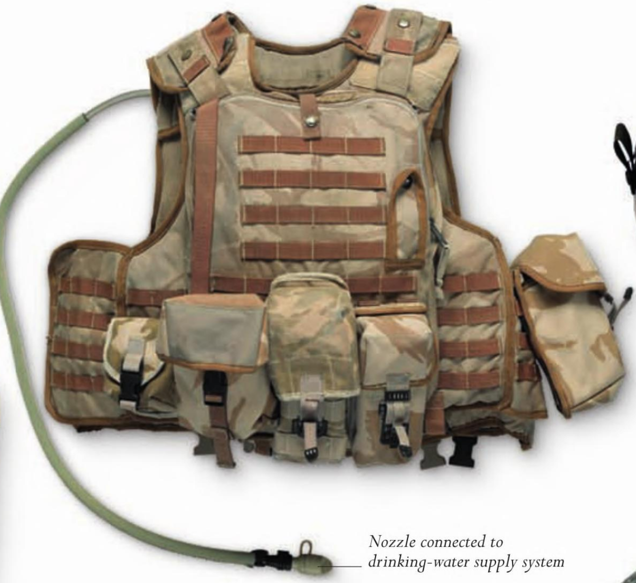
Origin UK

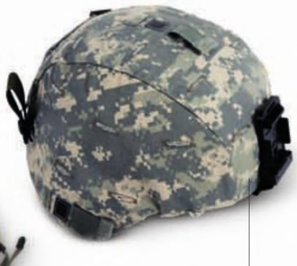
Material Suede, Cordura, rubber

Lightweight patrol boots were designed for use in warm weather. They have been used extensively by British troops operating in Iraq and Afghanistan.

Rubber sole

Two-colour camouflage
Two-tone desert Disruptive Pattern Material (DPM)


Nozzle connected to drinking-water supply system


Cloth cover in Universal Camouflage Pattern (UCP)

◀ US ARMY ADVANCED COMBAT HELMET

Date 2003

Origin US

Material Ballistic fibre

The US Army's successor to the PASGT helmet, the Advanced Combat Helmet (ACH) shares similarities with the US Marines Lightweight Helmet (LWH). Like the LWH, the ACH is lighter and smaller than its predecessor and makes use of the latest ballistic-material technology.

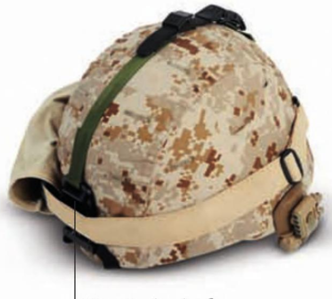
▲ OSPREY BODY ARMOUR

Date 2006

Origin UK

Material Kevlar, ceramic plates

Developed as a modular system, Osprey Body Armour enables protective elements for the upper arms, neck, and throat to be added to the main vest, which protects the torso.


Mounting bracket for night-vision aids

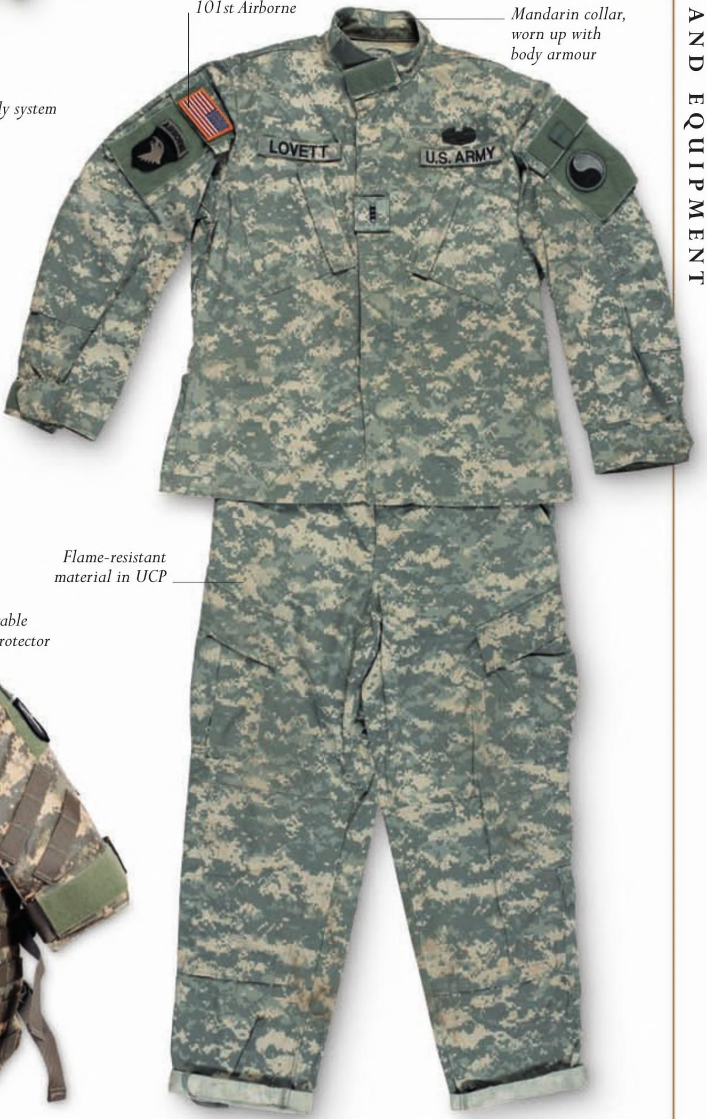
◀ US MARINE CORPS LIGHTWEIGHT HELMET

Date 2004

Origin US

Material Ballistic armour

Developed for the US Marines, the Lightweight Helmet (LWH) has a complex suspension and chinstrap configuration, which offers greater comfort and less weight than its predecessor, the PASGT.


Formation insignia: 101st Airborne
Mandarin collar, worn up with body armour
LOVETT
U.S. ARMY
Flame-resistant material in UCP

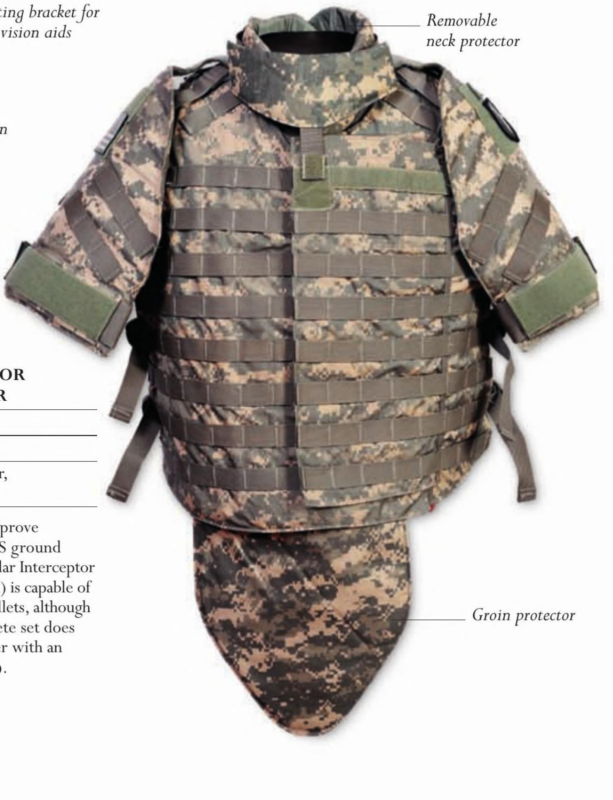
▲ ARMY COMBAT UNIFORM

Date 2002

Origin US

Material Cotton/nylon mix

The Army Combat Uniform (ACU) makes extensive use of Velcro fastenings. The cloth material is both flame-resistant and impregnated with the insecticide permethrin.


Removable neck protector
Groin protector

▶ INTERCEPTOR BODY ARMOR

Date 2007

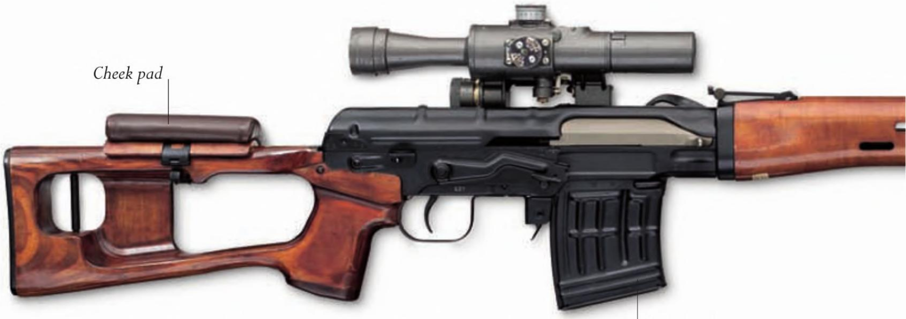
Origin US

Material Kevlar, ballistic panels

Developed to improve protection for US ground troops, the modular Interceptor Body Armor (IBA) is capable of stopping most bullets, although wearing a complete set does burden the soldier with an extra 15kg (33lb).

SNIPER RIFLES

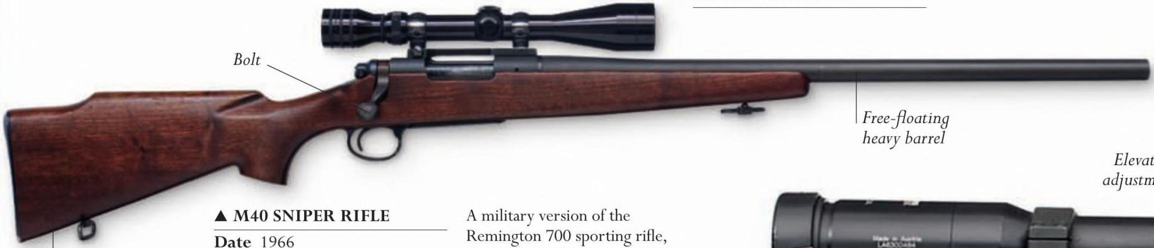
Military sniper rifles traditionally derived from two sources: first, the improved military rifle, fitted with a telescopic sight and firing match-grade ammunition; and secondly, the hunting rifle, which although highly accurate was often insufficiently robust for field conditions. During the late 1960s, small-arms designers finally began to produce rifles specifically designed for sniping. The M40 and the SS69 led the way, and were followed by a succession of superbly accurate firearms, such as the L96A1. Recent developments include the introduction of the 50-calibre heavy sniper rifle, and the .300 Winchester and .338 Lapua Magnum rounds, which are increasingly replacing the standard 7.62mm NATO cartridge.


Cheek pad
Ten-round detachable box magazine

▲ DRAGUNOV SVD

Date 1963
Origin Soviet Union
Weight 4.3kg (9½lb)
Barrel 61cm (24in)
Calibre 7.62 × 54R

The SVD came to be used as a sharpshooter platoon-support weapon by Warsaw Pact armies in the 1960s. Its four-power PSO-1 telescopic sight has limited infrared capability.


Bolt
Free-floating heavy barrel
Wooden stock

▲ M40 SNIPER RIFLE

Date 1966
Origin US
Weight 3.1kg (6¾lb)
Barrel 61cm (24in)
Calibre 7.62 × 51mm

A military version of the Remington 700 sporting rifle, the M40 was first used by the US Marine Corps in Vietnam. Subsequent models were equipped with a fibreglass stock and a Unertl ten-power scope.

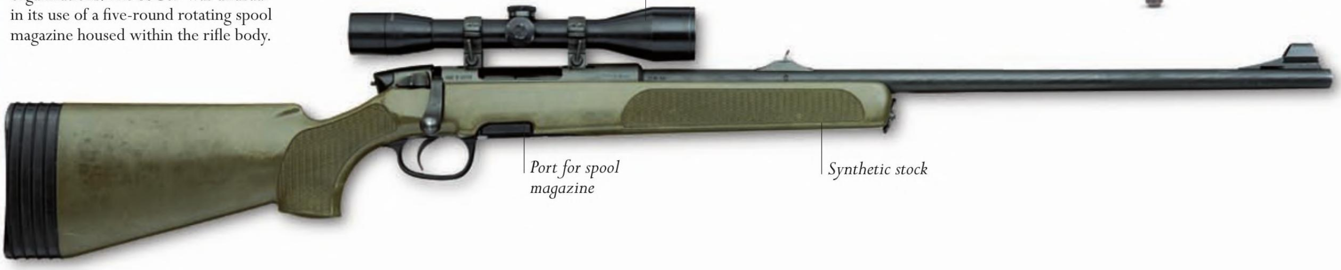
Elevation adjustment
Bolt handle
Five-round removable box magazine

Ten-power telescopic sight

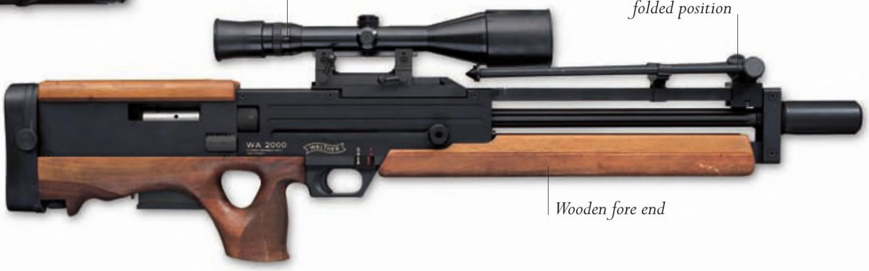
▼ STEYR SSG69

Date 1969
Origin Austria
Weight 3.9kg (8½lb)
Barrel 65cm (25½in)
Calibre 7.62 × 51mm

Developed for the Austrian army, the SSG also proved popular with police organizations. The SSG69 was unusual in its use of a five-round rotating spool magazine housed within the rifle body.


Six-power Kahles ZF69 telescopic sight
Port for spool magazine
Synthetic stock

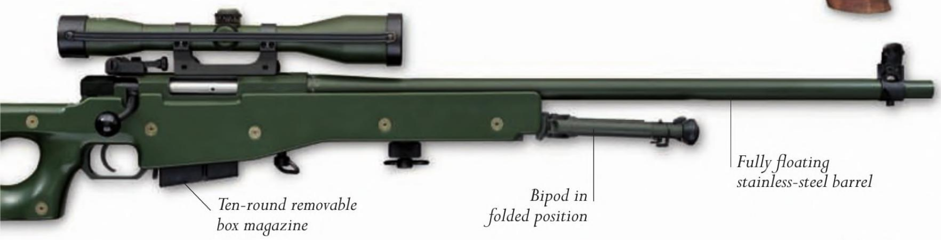
Gas cylinder


Magnification selector, 2.5–10x
Bipod in folded position
Wooden fore end

▶ WALTHER WA2000

Date	1978
Origin	Germany
Weight	6.95kg (15¼lb)
Barrel	65cm (25½in)
Calibre	.300 Win Mag/7.62mm

Developed primarily for police use, the WA2000 employed a "bullpup" configuration and a semiautomatic action fed by a six-round magazine. High manufacturing costs ended its production in 1988.

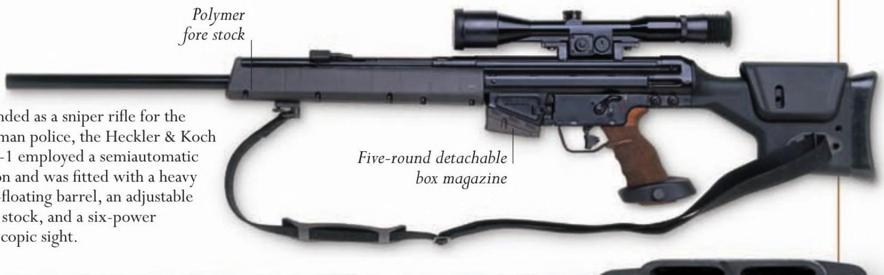

Ten-round removable box magazine
Bipod in folded position
Fully floating stainless-steel barrel

◀ L96A1

Date	1984
Origin	UK
Weight	6.5kg (14¼lb)
Barrel	65.5cm (25¾in)
Calibre	7.62 × 51mm

The British Army's L96A1 sniper rifle was the first to be developed specifically for sniping, and it became the forerunner of a whole series of sniper rifles produced in a variety of calibres.

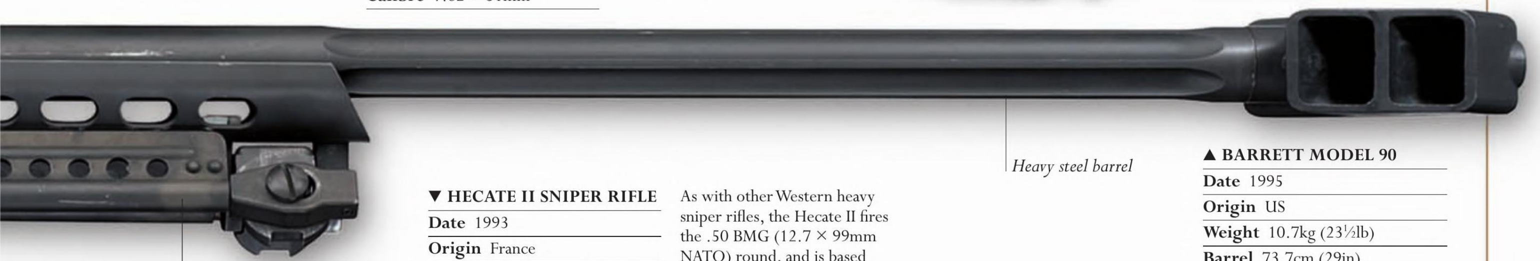
Objective lens


Polymer fore stock
Five-round detachable box magazine

▶ HECKLER & KOCH PSG-1

Date	1985
Origin	Germany
Weight	8.1kg (17¾lb)
Barrel	65cm (25½in)
Calibre	7.62 × 51mm

Intended as a sniper rifle for the German police, the Heckler & Koch PSG-1 employed a semiautomatic action and was fitted with a heavy free-floating barrel, an adjustable butt stock, and a six-power telescopic sight.


Heavy steel barrel
Bipod (folded)

▲ BARRETT MODEL 90

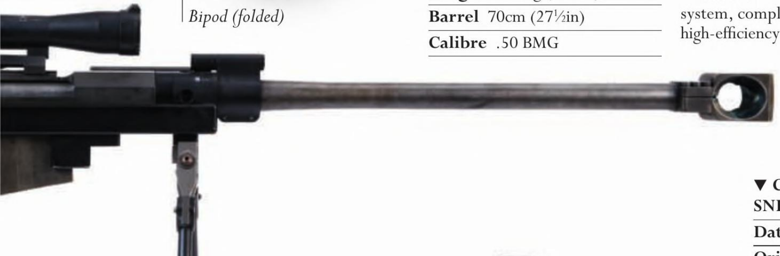
Date	1995
Origin	US
Weight	10.7kg (23½lb)
Barrel	73.7cm (29in)
Calibre	.50 BMG

Ronnie Barrett pioneered the anti-materiel (AM) rifle in the early 1980s. This model, noteworthy for its compact "bullpup" design, is an effective sniping weapon for ranges in excess of 1,800m (5,900ft).

▼ HECATE II SNIPER RIFLE

Date	1993
Origin	France
Weight	13.8kg (30½lb)
Barrel	70cm (27½in)
Calibre	.50 BMG

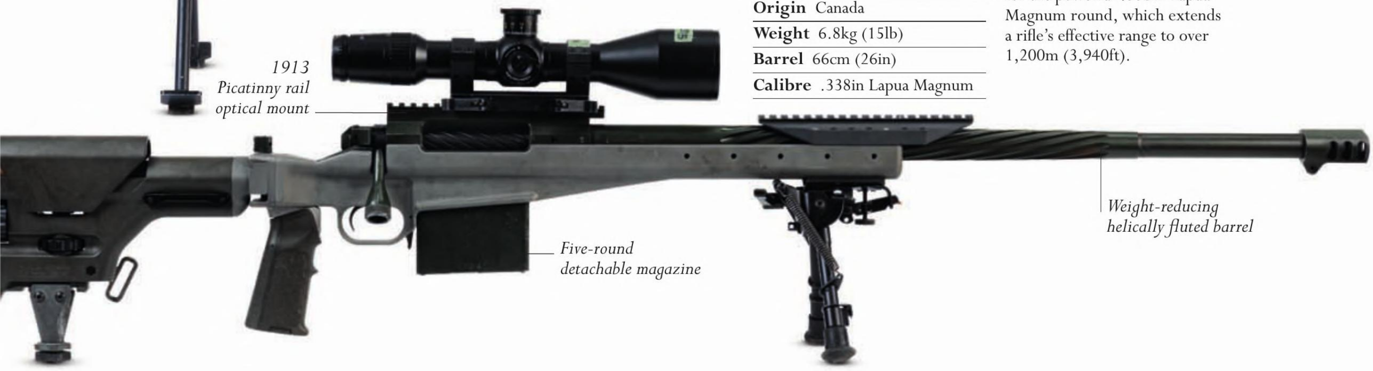
As with other Western heavy sniper rifles, the Hecate II fires the .50 BMG (12.7 × 99mm NATO) round, and is based around PGM's metallic skeleton system, complete with a high-efficiency muzzle brake.



▼ C14 TIMBERWOLF SNIPER RIFLE

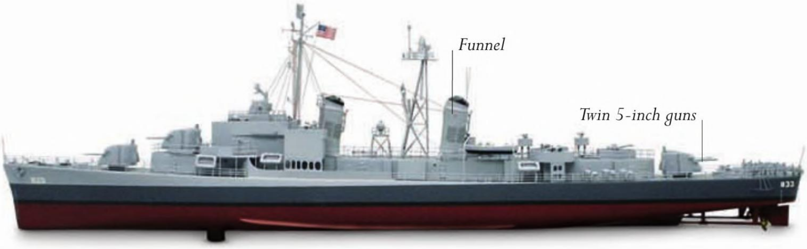
Date	2005
Origin	Canada
Weight	6.8kg (15lb)
Barrel	66cm (26in)
Calibre	.338in Lapua Magnum

Following recent trends in antipersonnel sniper-rifle design, the Timberwolf has been chambered for the powerful .338in Lapua Magnum round, which extends a rifle's effective range to over 1,200m (3,940ft).


1913 Picatinny rail optical mount
Five-round detachable magazine
Weight-reducing helically fluted barrel

MODERN FRIGATES AND DESTROYERS

While the aircraft carrier and the nuclear-powered submarine are the capital ships of today's major naval forces, smaller escort vessels remain as necessary as ever. The distinction between destroyers and frigates has become more indefinite during the post-war era, with the (larger) destroyer and the (smaller) frigate dispensing with some of their guns in favour of an array of guided missiles as their main armament. Escort vessels have usually been classified into anti-aircraft or anti-submarine vessels, but most are capable of performing a variety of tasks.


Funnel
Twin 5-inch guns

▲ USS HERBERT J THOMAS

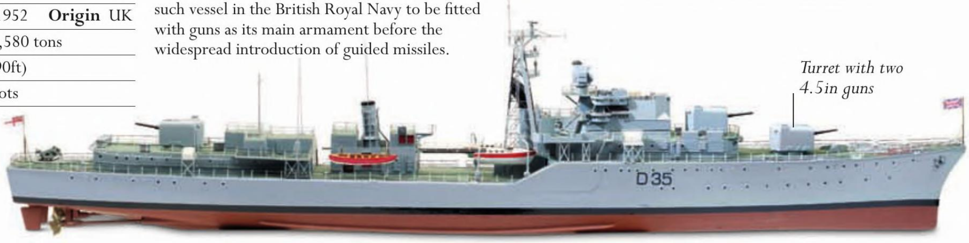
Commissioned 1945 **Origin** US
Displacement 3,460 tons
Length 119m (390ft)
Top speed 36.8 knots

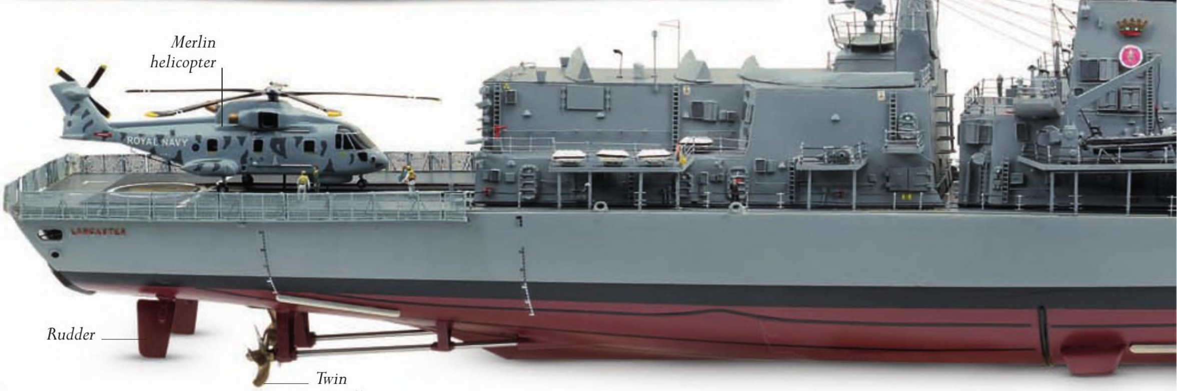
One of 98 *Gearing*-class anti-aircraft destroyers, the *Herbert J Thomas* was designed for long-range patrols in the Pacific, and was armed with six 5-inch guns in three turrets. It took part in both the Korean and Vietnam Wars.

▶ HMS DIAMOND

Commissioned 1952 **Origin** UK
Displacement 3,580 tons
Length 119m (390ft)
Top speed 30 knots

As a *Daring*-class destroyer, *Diamond* was the last such vessel in the British Royal Navy to be fitted with guns as its main armament before the widespread introduction of guided missiles.

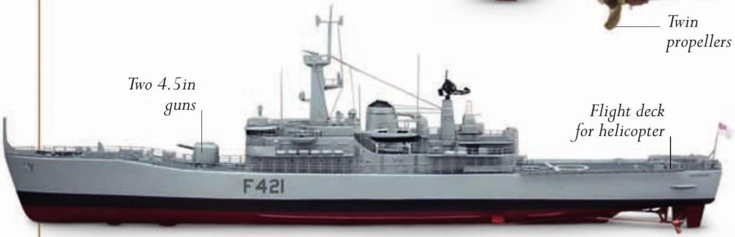

Turret with two 4.5in guns


Funnel
Merlin helicopter
Rudder
Twin propellers

▶ HMS LANCASTER

Commissioned 1992 **Origin** UK
Displacement 4,200 tons
Length 133m (436ft)
Top speed 32 knots

A Type-23 frigate, *Lancaster* is a versatile multirole vessel, armed with Sea Wolf anti-aircraft missiles, Harpoon anti-ship missiles, and Stingray anti-submarine torpedoes.


Two 4.5in guns
Flight deck for helicopter

▲ HMNZCS CANTERBURY

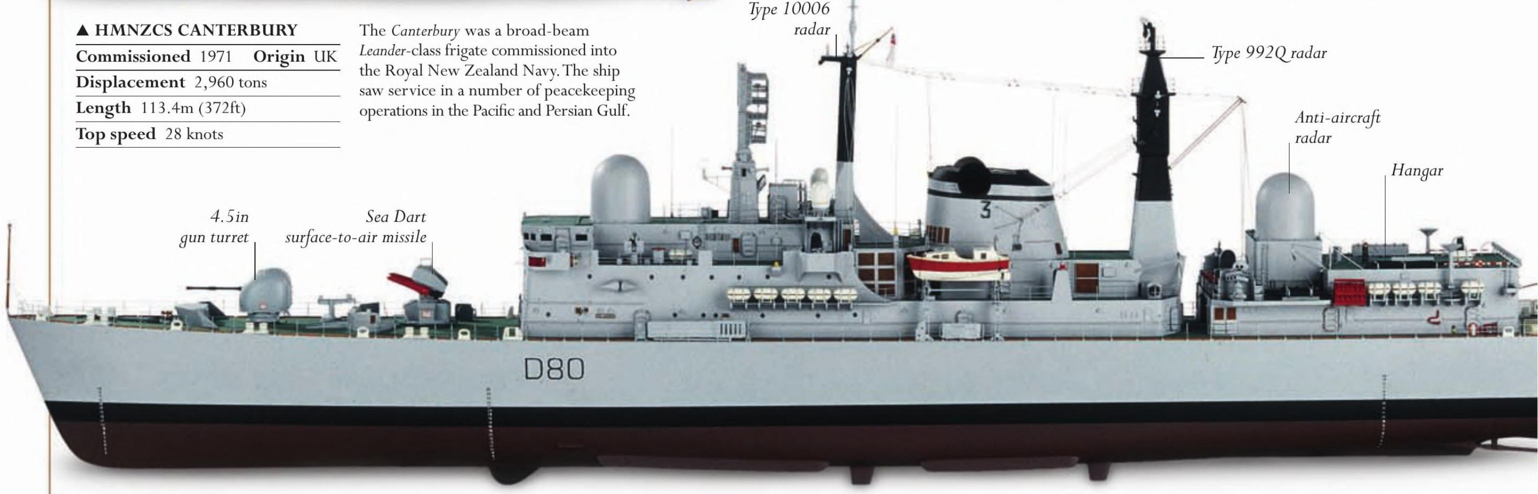
Commissioned 1971 **Origin** UK
Displacement 2,960 tons
Length 113.4m (372ft)
Top speed 28 knots

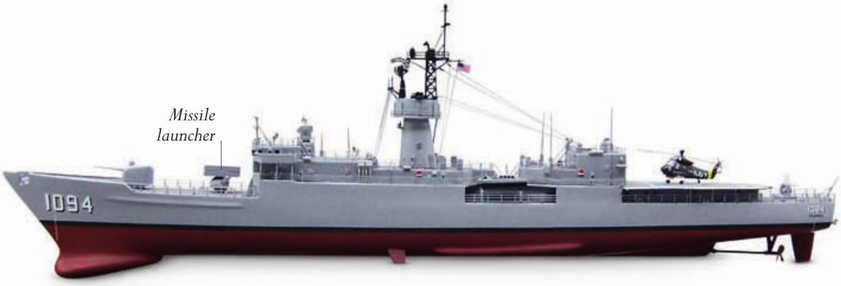
The *Canterbury* was a broad-beam *Leander*-class frigate commissioned into the Royal New Zealand Navy. The ship saw service in a number of peacekeeping operations in the Pacific and Persian Gulf.

▼ HMS SHEFFIELD

Commissioned 1975 **Origin** UK
Displacement 4,350 tons
Length 125m (410ft)
Top speed 30 knots

A Type-42 Guided Missile Destroyer, *Sheffield* took part in the Falklands campaign of 1982. While on patrol off the Falkland Islands, *Sheffield* was sunk by an Exocet missile fired by an Argentinian naval aircraft.


Type 10006 radar
Type 992Q radar
Anti-aircraft radar
Hangar
4.5in gun turret
Sea Dart surface-to-air missile


Missile launcher

◀ **USS PHARRIS**

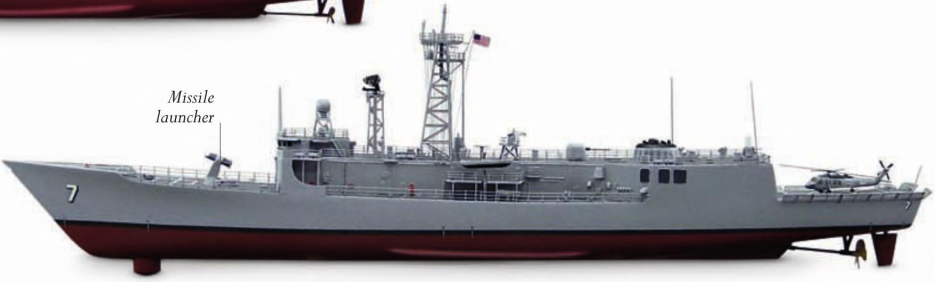
Commissioned 1974 **Origin** US

Displacement 4,070 tons

Length 133.5m (438ft)

Top speed 27 knots

The *Pharris* was launched as a *Knox*-class destroyer, and was later reclassified as a frigate. It was intended for anti-submarine warfare duties, being armed with Anti-Submarine Rocket (ASROC) and Harpoon missiles.


Missile launcher

▲ **USS OLIVER HAZARD PERRY**

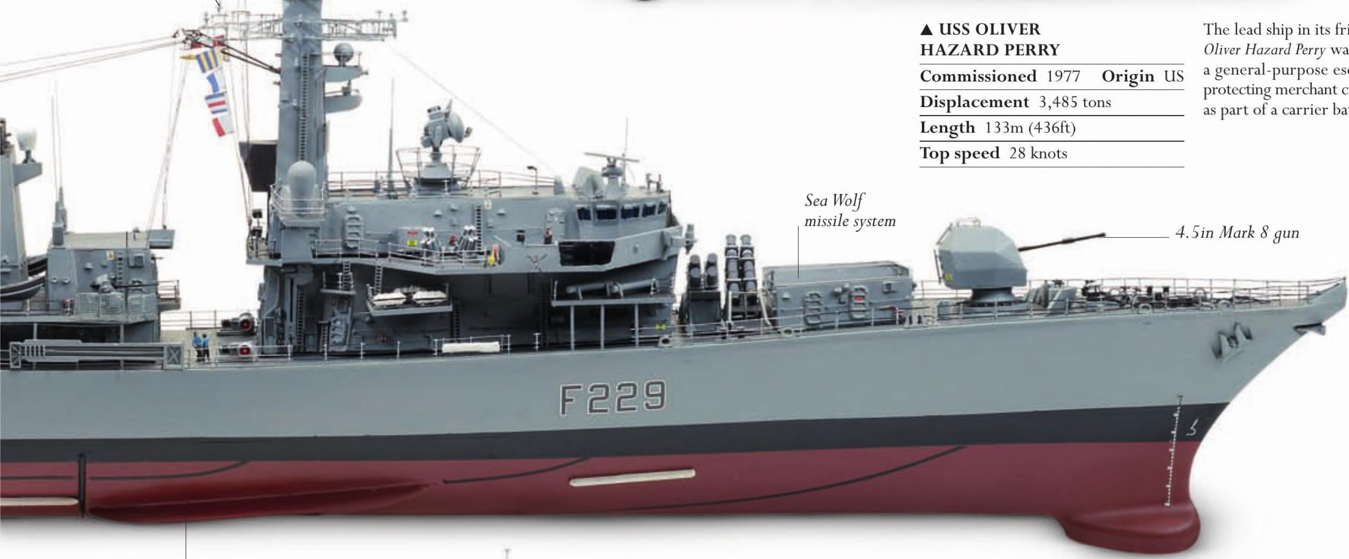
Commissioned 1977 **Origin** US

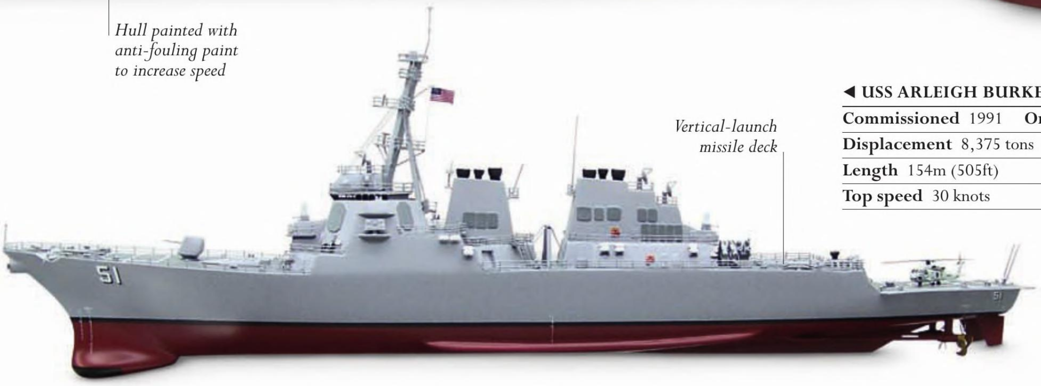
Displacement 3,485 tons

Length 133m (436ft)

Top speed 28 knots

The lead ship in its frigate class, the *Oliver Hazard Perry* was designed as a general-purpose escort vessel, protecting merchant convoys or acting as part of a carrier battle group.


Radar and electronics mast
Sea Wolf missile system
4.5in Mark 8 gun
Hull painted with anti-fouling paint to increase speed


Vertical-launch missile deck

◀ **USS ARLEIGH BURKE**

Commissioned 1991 **Origin** US

Displacement 8,375 tons

Length 154m (505ft)

Top speed 30 knots

The first destroyer to be fitted with the advanced AEGIS missile system, the *Arleigh Burke* also incorporates the latest stealth technology. It is the lead-ship of its class of guided-missile destroyers.

▶ **HMCS VANCOUVER**

Commissioned 1993

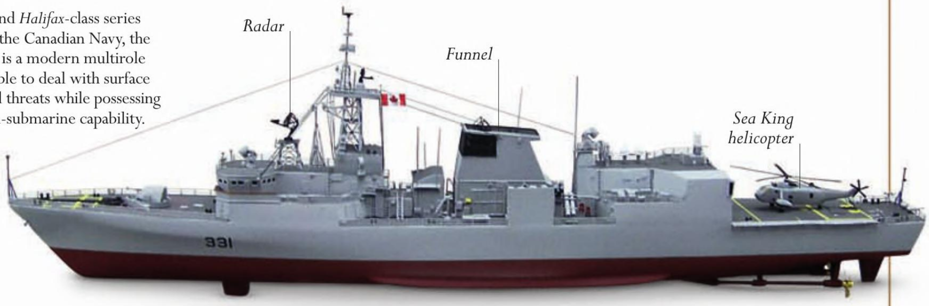
Origin Canada

Displacement 4,750 tons

Length 134m (440ft)

Top speed 30 knots

The second *Halifax*-class series vessel of the Canadian Navy, the *Vancouver* is a modern multirole frigate, able to deal with surface and aerial threats while possessing a full anti-submarine capability.


Radar
Funnel
Sea King helicopter

AMERICAN AIRCRAFT CARRIER

USS GEORGE WASHINGTON

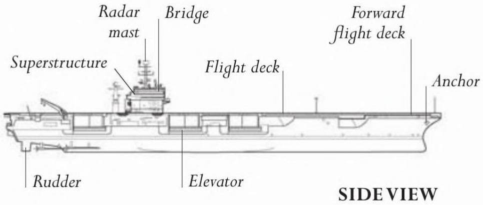
Aircraft carriers are the ultimate symbol of naval power. The *George Washington* is one of 10 Nimitz-class supercarriers in the US Navy – the largest military vessels ever to take to the seas.

Commissioned in 1992, the *George Washington* can accommodate 85 aircraft, including fighter, strike, and transport planes, airborne early warning (AEW) aircraft, and helicopters. It is also a floating home for around 6,000 service men and women. Although designed primarily to offer an offensive strike capability, the ship is equipped with its own defences, such as anti-aircraft and anti-missile weapon systems, and rapid-fire 20mm guns.

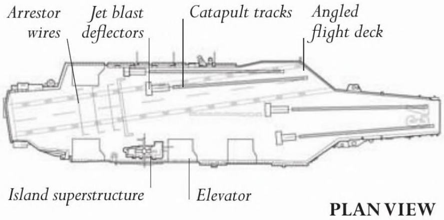
On the starboard side and overlooking the deck is the island superstructure – the ship's command-and-control centre, which houses the bridge and primary flight-control area. From here, officers keep a careful watch on the massive flight deck, which covers 1.8 hectares (4.5 acres) – about the size of two-and-a-half soccer pitches.

During flying operations, the deck is a hive of activity, with aircraft taking off and landing, and being manoeuvred, refuelled, and armed. Aircraft are launched by four catapults, two at the forward end of the angled deck and two in the bows. The landing deck is angled to the port side to allow other activities to take place as aircraft return to the ship. When touching down, a pilot must ensure that the plane's tailhook catches one of four high-tensile steel arrestor wires that run across the flight deck. These decelerate the aircraft rapidly and bring it to a halt within two seconds.

When not in use, most aircraft are stored beneath the flight deck in the vast hangar, which stretches for much of the ship's length. On the decks below are living quarters for the ship's personnel.



SIDE VIEW

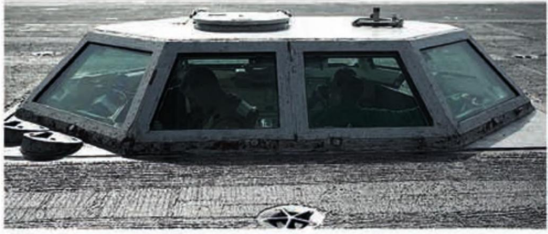


PLAN VIEW

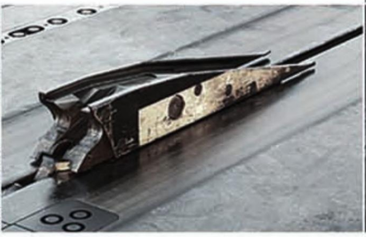
▲ **USS *GEORGE WASHINGTON***
The sixth Nimitz-class carrier, the *George Washington* is 333m (1,092ft) long and displaces about 103,000 tons. It is powered by two nuclear reactors.

▼ **PREPARING FOR TAKE-OFF**
Deck crew secure a Northrop Grumman E-2C Hawkeye AEW aircraft to a catapult shuttle.

TAKE-OFF AND LANDING

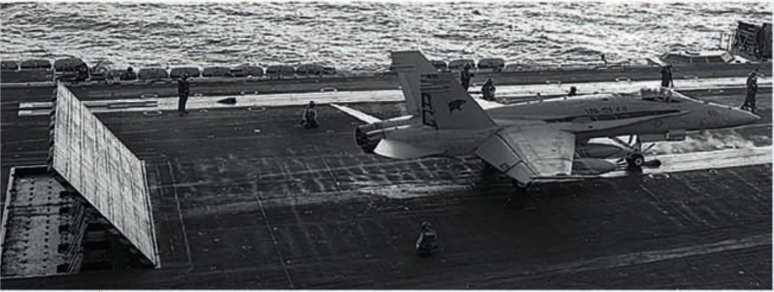


▲ **CATAPULT CONTROL POD**
This observation pod, which retracts below the flight deck, enables the crew controlling catapult launches to see what is happening while remaining safe from moving aircraft and their exhausts.



▲ **CATAPULT SHUTTLE**
For a catapult launch, a shuttle is attached to a plane's undercarriage and propelled along a track by a steam-powered piston.

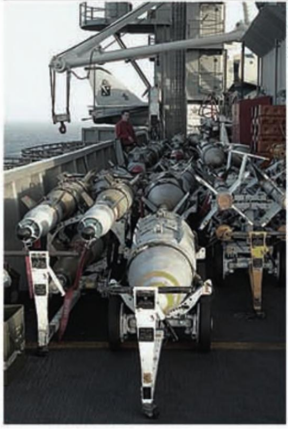
▲ **SHUTTLE TRACK**
The catapult shuttle runs along a track set into the surface of the ship's flight deck.



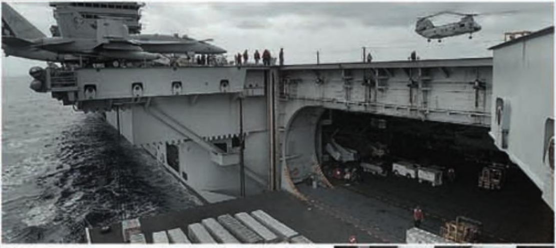
▲ **JET-BLAST DEFLECTOR**
The yellow deflector shield behind this McDonnell Douglas F/A-18 Hornet prevents the plane's exhaust from causing damage or injury during take-off. The deflector shield is cooled by sea water.

▲ **GRUMMAN F-14 TOMCAT LANDING**
A pilot increases the throttle at touch-down, so that if the aircraft fails to catch the arrestor wires it still has enough speed to take off again and attempt another landing – a practice called "touch and go".

AROUND THE DECK

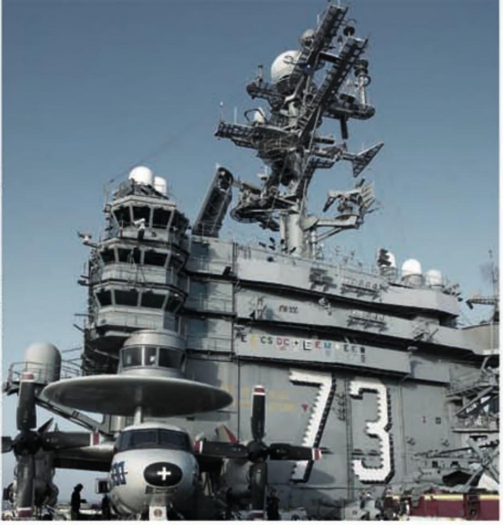


▲ AIRCRAFT WEAPONRY Most of the *George Washington*'s formidable firepower is reserved for its aircraft. The range of airborne weapons include bombs, rockets, guided missiles, and torpedoes.



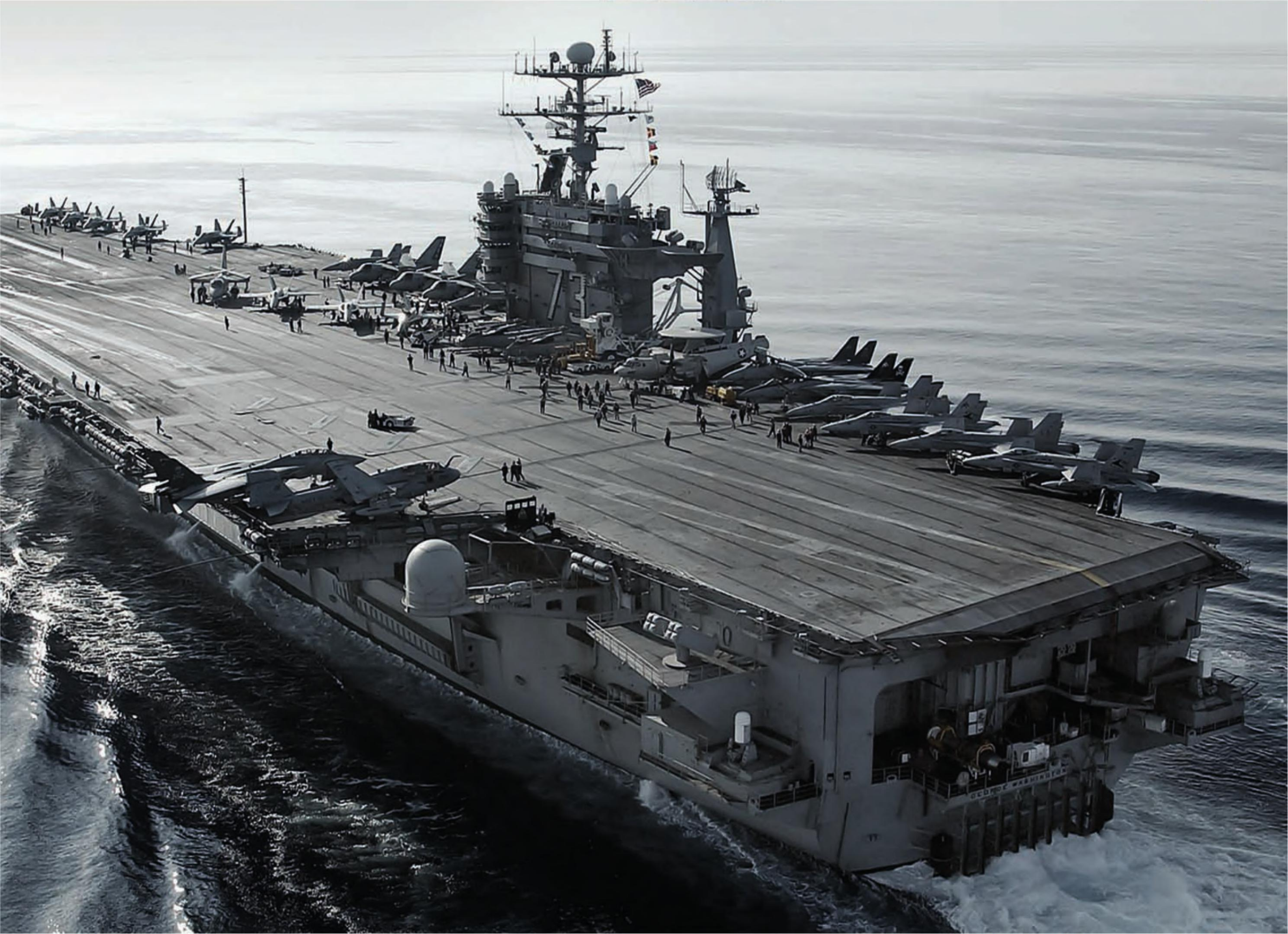
▲ ELEVATOR Four hydraulic lifts, one to port and three to starboard, move aircraft between the hangar and the flight deck. They also take containers of stores or spare parts to and from the hangars.

▶ HELICOPTER MAINTENANCE An aircraft carrier's helicopters perform many roles, including anti-submarine work, rescue missions, and the transportation of personnel.



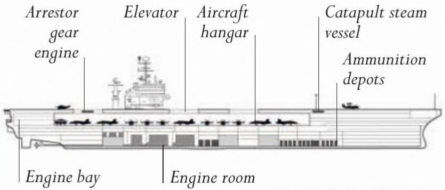
▲ ISLAND SUPERSTRUCTURE Much of the electronics, including radar and satellite communications equipment, is based on the island, which has the ship's number painted on its sides.

▼ FLOATING AIRSTRIP Carriers such as the *George Washington* provide the strategic benefit of a mobile strike platform that can operate from anywhere in international waters.



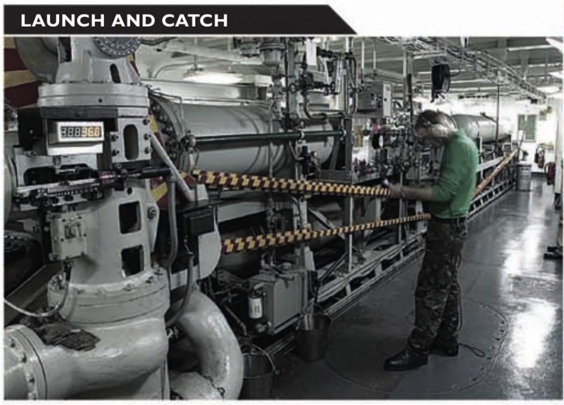
INSIDE AND DOWN BELOW

The control rooms are based in the island superstructure up above and elsewhere below deck. In addition to the aircraft hangar, the lower-deck areas include the catapult and arrestor gear machinery, 44 magazines, and the power plant and engine room. Facilities for the thousands of crew and air wing include messes, medical facilities, and a gym.

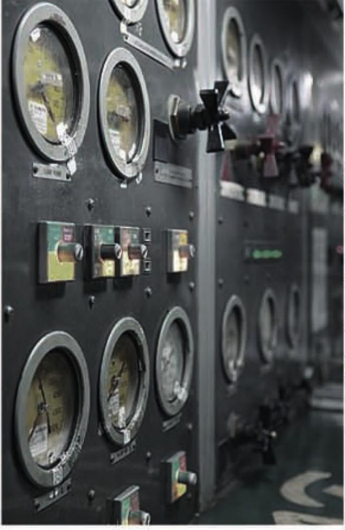


CROSS-SECTION

LAUNCH AND CATCH

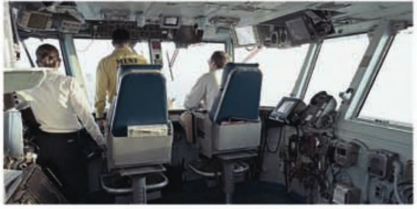


▲ ARRESTING GEAR PISTON
Huge hydraulic pistons below the *George Washington*'s flight deck provide the power to rein in the arrestor wires as they are caught by planes landing at speeds of up to 240kph (150mph).

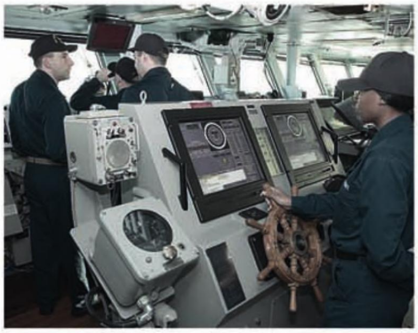


▲ INSTRUMENT PANEL
Gauges show the steam pressure in the catapult mechanisms. The ship can launch four planes per minute.

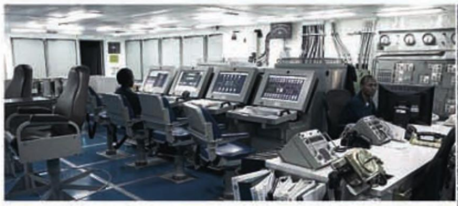
CONTROL ROOMS



▲ PRIMARY FLIGHT CONTROL
Overlooking the deck, the air boss in charge of the ship's aircraft coordinates all take-offs and landings. The windows are angled to reduce glare.

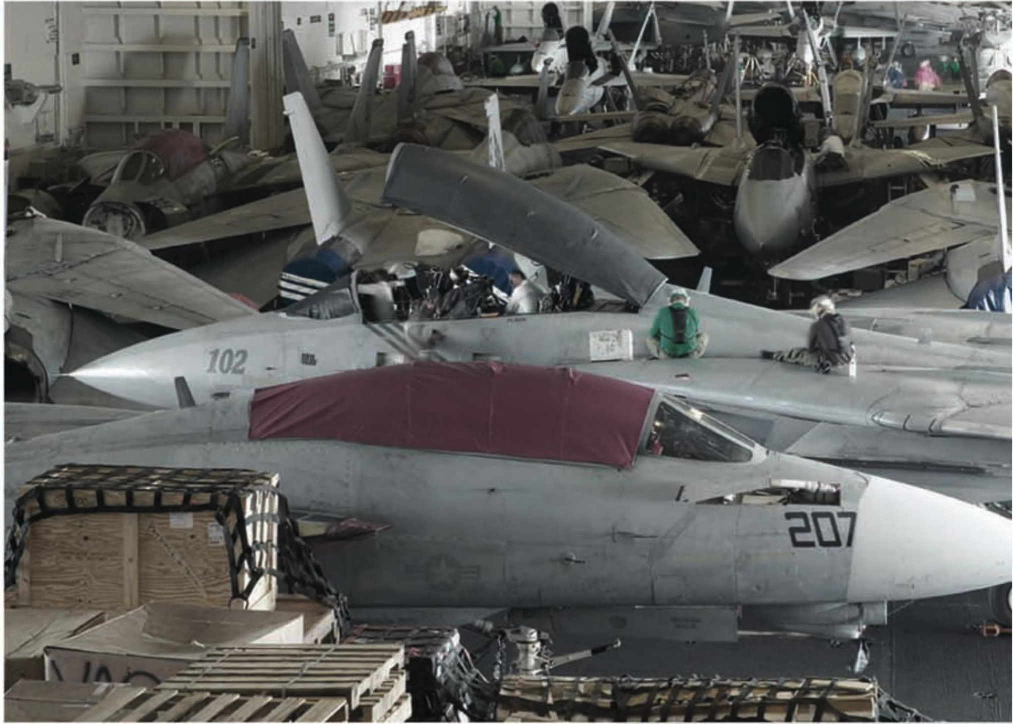


▲ BRIDGE
The bridge gives panoramic views of the sky and ocean. From here, the captain or watch officer oversees navigation and steering.



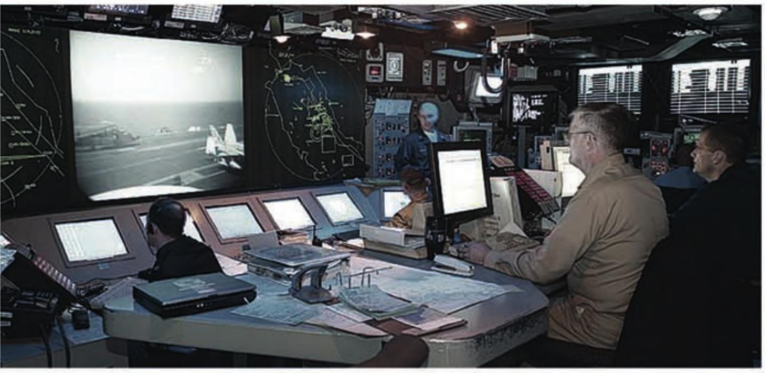
▲ REACTOR CONTROLS
The reactors are controlled remotely from this room. The ship can run for a year on a fuel pellet the size of a soft drinks can. It has enough fuel to run non-stop for 18 years.

AIRCRAFT HANGAR

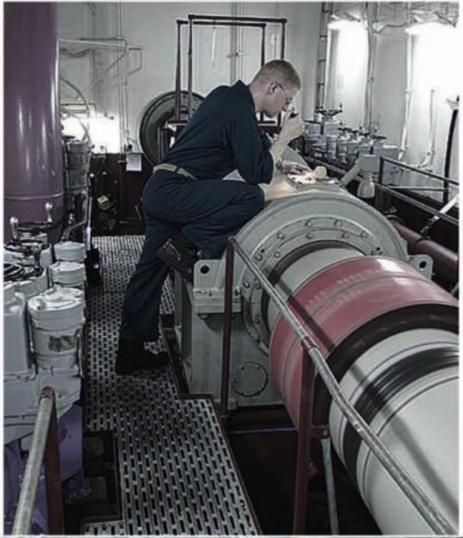


◄ NO. 3 PUMP ROOM
JP5 aviation fuel is pumped up to the flight deck. To reduce the risk of fire, JP5 has a lower ignition temperature than commercial fuel.

LIFE BELOW DECKS



▲ OPERATIONS ROOM
Staff monitor take-offs, landings, and activities on the flight deck via television screens, and use radar to direct airborne planes. In the event of an attack, the defence systems are also operated from here.

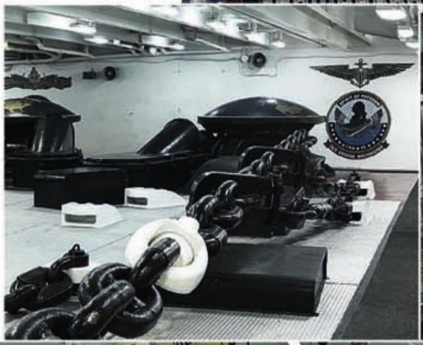


◄ PROPELLER SHAFT
An engineer checks a shaft that drives one of the four propellers. Powered by the ship's twin nuclear reactors, a quartet of five-bladed propellers give *George Washington* a top speed in excess of 30 knots.

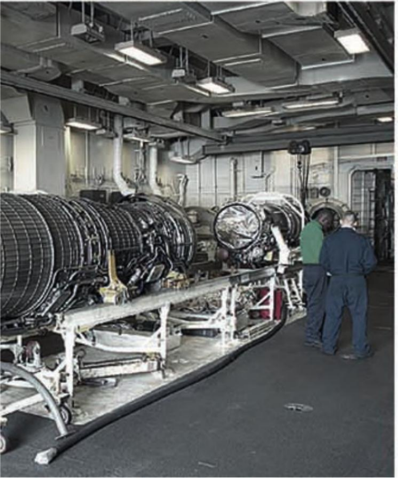
▼ BAKERY
Along with the galley, the bakery helps to provide around 18,000 meals each day. The large ovens are visible in the background.

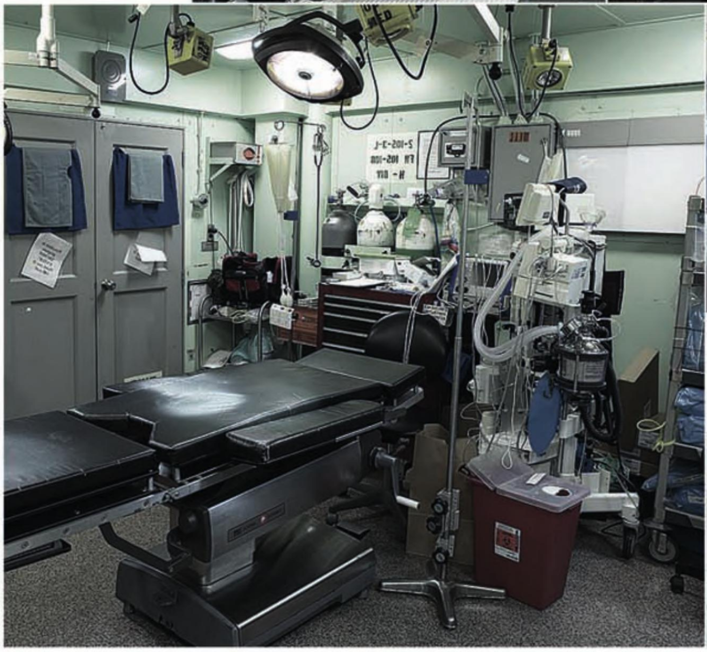
◄ HANGAR
Aircraft are serviced in the hangar. Each of the staff involved have a specific jacket colour that denotes their role: for example, a general maintenance petty officer wears a green one, while brown denotes a plane captain – responsible for the upkeep of a specific aircraft.

► ANCHOR CHAINS
The *George Washington* has a pair of 30-tonne, stockless anchors. The anchor chains run through the bows, where they are stored when not in use. Each chain link weighs approximately 160kg (360lb).



▼ ENGINE BAY
The maintenance, testing, and storage of engines takes place in this bay. An F-14 Tomcat engine can be seen here, with the engine of an F/A-18 Hornet visible in the background.





▲ OPERATING THEATRE
The ship's medical department must be ready for almost any kind of illness, accident, or battle casualty. In an average year, the medical team sees over 10,000 patients, processes around 3,000 X-rays, and performs more than 100 surgical operations.

▲ BRIEFING ROOM
Flight instructions are given in the briefing room. Each seat is assigned to a specific pilot.

▲ DRINKING FOUNTAIN
Distilling plants daily produce 1.5 million litres (330,000 gallons) of fresh water from sea water.

KEY **OPERATION**

OPERATION NEPTUNE SPEAR

2 MAY 2011

The killing of the al-Qaeda (see p.408) leader Osama bin Laden by US SEAL Special Forces, on 2 May 2011, was achieved through a combination of intelligence and technology. Bin Laden's Pakistani hideout was observed by satellites, and then by the covert Sentinel stealth UAV. The US SEALs were transported by stealth UH-60 Black Hawk helicopters and carried the latest equipment, including suppressed carbines, night-vision goggles, and body armour.

▲ Osama bin Laden was the founder of al-Qaeda, the jihadist group responsible for the terrorist attacks on the US, on 11 September 2001 (see p.408).

KEY DEVELOPMENT

THE HIGH-TECH BATTLEFIELD

The pursuit of technology to improve battlefield performance continues at an ever-increasing pace. In a race currently led by the US, all the major military nations are incorporating the latest scientific and technological advances into their weapon systems.

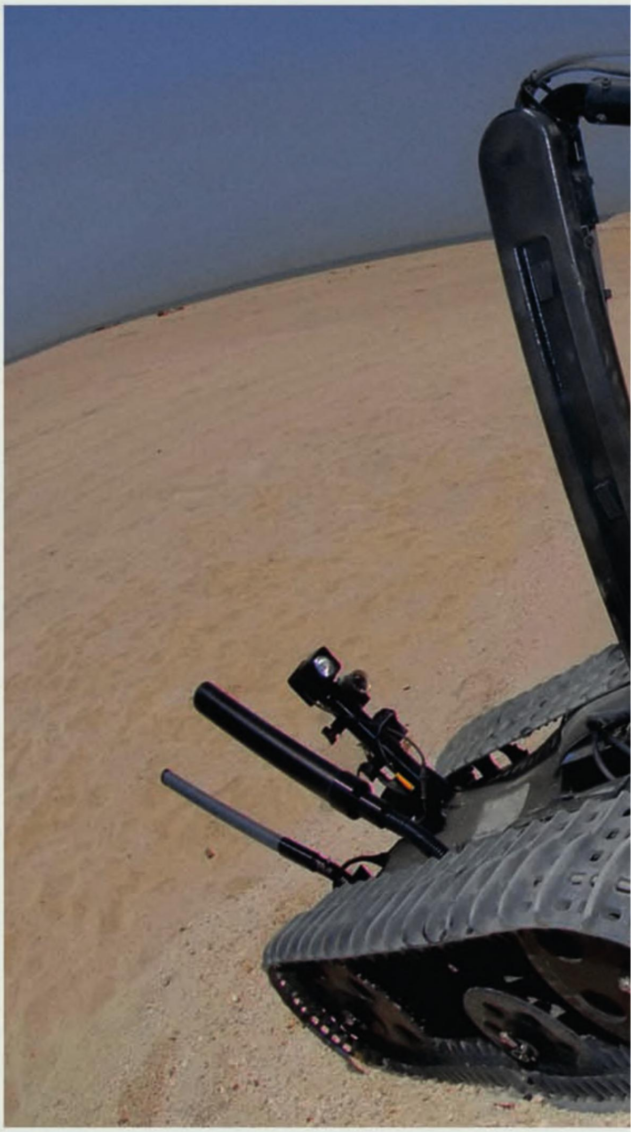
The development of the unmanned aerial vehicle (UAV) has brought about a profound change to the way battles are fought. Towards the end of the 20th century, the UAV had already established itself as a valuable reconnaissance tool; in particular, the RQ-4 Global Hawk and the Predator and Reaper drones have revolutionized the process of gathering strategic and tactical intelligence. Post-2000, the UAV has also assumed the role of hunter-killer. The MQ-9 Reaper, for example, can be armed with up to 14 Hellfire air-to-ground missiles or two Paveway II laser-guided bombs. It has seen extensive use in Afghanistan, where it is controlled via a real-time satellite link from an air force base in Nevada, some 9,600km (6,000 miles) away. A further advantage of the UAV is its airborne endurance: the Israeli Eitan, for example, can stay airborne for up to 70 hours.

UNMANNED VEHICLES ON LAND

As part as the American-led move towards the "automated battlefield", unmanned vehicles are also used on land. This began with remote-controlled bomb-disposal machines, but in recent years, larger, more complex vehicles have been produced, including the remote-controlled Black Knight tank, which is based on the M2 Bradley infantry combat vehicle. An intriguing development has been the Israeli remote-controlled robotic snake. Used for surveillance in confined, hostile environments, it is equipped with a camera and microphone.

Progress made in applying stealth technology to standard front-line aircraft (such as the US F-35) has now been extended to warships and armoured vehicles. Developments in Adaptive Camouflage allow such high-profile ground objects as a main battle tank to be hidden from infra-red sensors. And, heading into the realms of science fiction, research has also been conducted into a material called Metaflex, which may be able to hide soldiers behind a kind of "invisibility cloak".

▼ XM25 GRENADE LAUNCHER
A US Army soldier tests an XM25 grenade launcher in Afghanistan. The XM25 uses computerized optical sights, and fires 25mm grenades set to explode in mid-air at or near the target, and also pre- or post-impact.

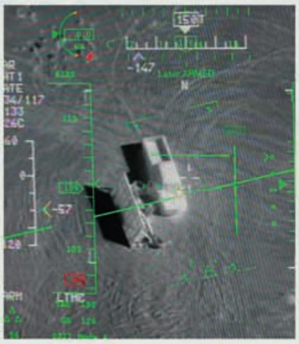


“Our **moral authority** is as **important** [as] our **troop strength** and our **high-tech weapons**”

ROBERT REICH, FORMER US SECRETARY OF LABOR, JULY 2004

Laser weapons have evolved into two distinct categories. Laser rifles, such as the American TR3 and PHASR, cause temporary blindness, and are intended to discourage rather than kill. A second line of development consists of very powerful lasers, such as the experimental Laser Avenger, which is designed to shoot down incoming missiles.

For the soldier on the battlefield, the conflict in Afghanistan has been a testing ground for a whole range of new weapons. The XM-26 LSS under-barrel shotgun – which attaches to an M4 or M16-type assault rifle – enables door-breaching and close-range firepower, and can fire non-lethal projectiles such as tear gas. Another innovation is the H&K XM25 Counter-defilade Target Engagement (CDTE). This 25mm semi-automatic grenade launcher uses a “smart” laser range finder to ensure precise detonation of the grenade to a range of up to 1,000m (1,090 yards). The grenade measures the distance it travels by counting its own rotations.



▲ **AN MQ-9 REAPER IMAGE**
A display screen in a ground control station at a US Air Force base shows the view captured by a MQ-9 Reaper camera during a training mission.

KEY **EVENTS**

1970–PRESENT

- **1972** The Wheelbarrow bomb-disposal robot is developed for the British Army for use in Northern Ireland.
- **1982** The Lockheed F-117, the first aircraft to feature stealth technology, is adopted by the US Air Force (see pp.412–13).
- **1994** The Predator UAV makes its first flight. It is designed for reconnaissance only.
- **2001** The Reaper UAV is developed. It is larger and more versatile than the Predator.
- **2006** The F-35 Lightning II – a jet fighter with advanced stealth technology – goes into production.
- **2007** Reaper UAVs begin combat missions over Afghanistan.
- **2009** Combat field trials of the IAWS take place in Iraq and Afghanistan.
- **2010** Metaflex “invisible” material is developed.

FRONT
TOWARD ENEMY

◀ **A TALON 3B ROBOT**
A claymore land mine is removed from a sand dune by a Talon 3B robot during a training exercise in Bahrain. Designed to search and destroy Improvised Explosive Devices (IEDs), the robot is operated remotely by technicians using monitors and video equipment attached to the unit.

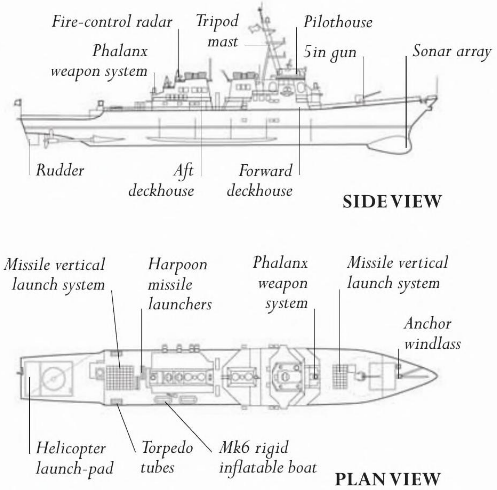
GUIDED-MISSILE DESTROYER

USS DONALD COOK

The US Navy's guided-missile destroyer *Donald Cook* saw action in the Iraq War. Deployed in Operation Iraqi Freedom in March 2003, it was among the first ships to launch strikes against Iraqi targets.

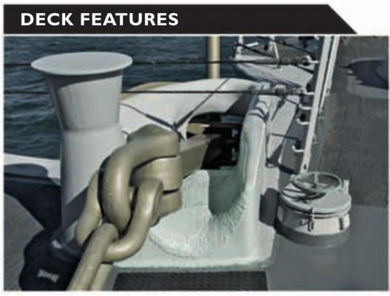
The *Donald Cook* and her fellow Arleigh Burke-class destroyers are among the most advanced surface warships in service today. Launched in 1997 and the 25th ship in the class, the *Donald Cook* belongs to Flight II, which embodies significant advances in armaments and electronics on earlier versions. The ship is packed with diverse weaponry, giving her what the US Navy calls "multi-mission offensive and defensive capabilities". The heart of the destroyer's offensive capabilities are the two Mk41 Vertical Launch Systems (VLS). These can fire anti-aircraft missiles, anti-submarine missiles, missiles for destroying other surface ships, and cruise missiles for strike operations against land targets. The ship also has a launch-pad from which an attack helicopter can operate.

The destroyer's design is intended to maximize its chances of surviving. The Arleigh Burke class were among the first ships to incorporate "stealth" technology, with buried funnels and angled shapes that reduce their radar profile, as well as features to suppress infrared emissions. They were also the first all-steel American warships. Using steel rather than aluminium for the destroyer's superstructure reduces damage in the event of a missile hit. The *Donald Cook* has a crew of 30 officers and over 300 enlisted personnel.


Fire-control radar
Tripod mast
Pilothouse
Phalanx weapon system
5in gun
Sonar array
Rudder
Aft deckhouse
Forward deckhouse
SIDE VIEW
Missile vertical launch system
Harpoon missile launchers
Phalanx weapon system
Missile vertical launch system
Anchor windlass
Helicopter launch-pad
Torpedo tubes
Mk6 rigid inflatable boat
PLAN VIEW

▲ **USS *DONALD COOK***
Despite being classed as a destroyer, *Donald Cook* is over 150m (500ft) long and displaces 8,400 tons, making her similar in size to many World War II cruisers.

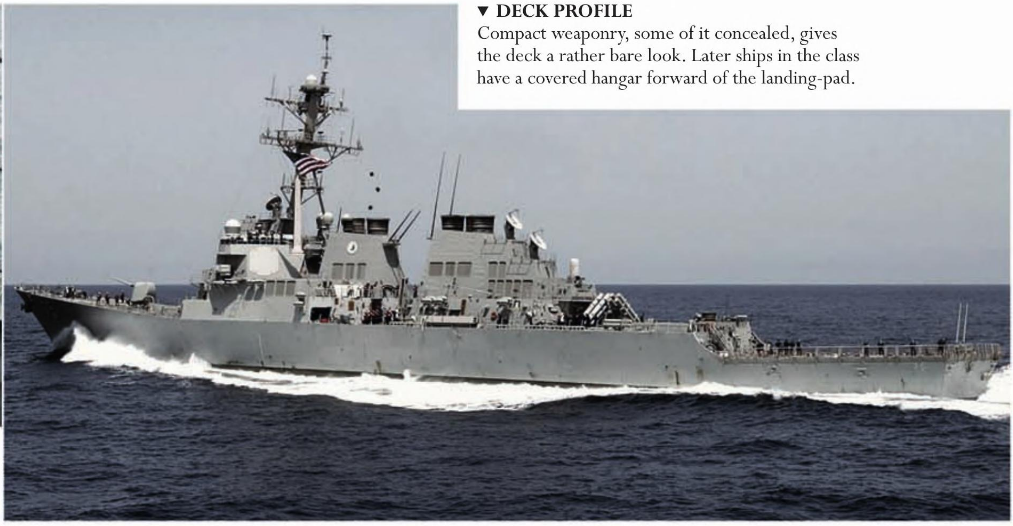
DECK FEATURES



▲ **ANCHOR CHAIN**
The two anchors are carefully positioned so that they do not strike the large sonar bulge on the ship's hull as they are lowered and raised.

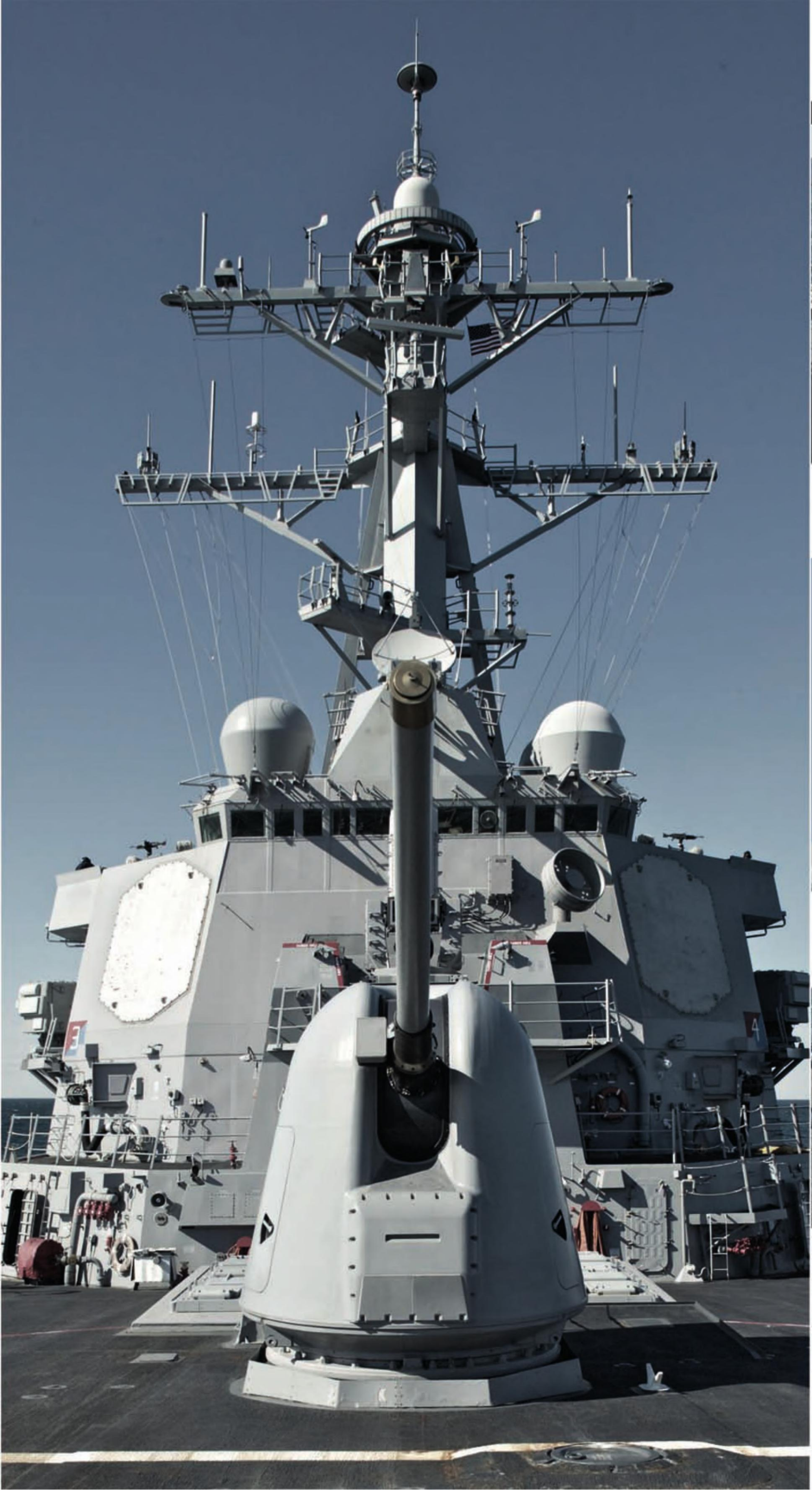
▲ **HELICOPTER LANDING-LIGHTS**
Green lights indicate a good approach, amber signal caution, and red mean that an incoming helicopter is too low. Flashing reds tell the pilot to abort the landing.

▲ **HELICOPTER LANDING-PAD**
The ship can embark and refuel a Sikorsky SH-60 Seahawk helicopter for search and attack missions or for transporting personnel and cargo.

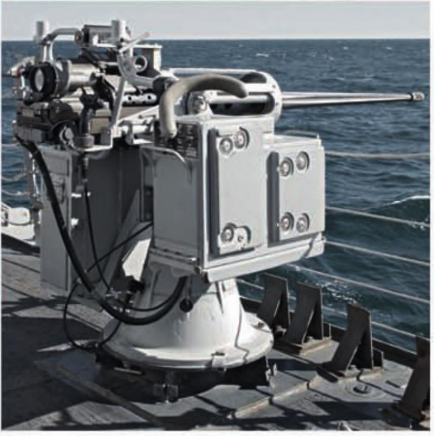


▼ **DECK PROFILE**
Compact weaponry, some of it concealed, gives the deck a rather bare look. Later ships in the class have a covered hangar forward of the landing-pad.

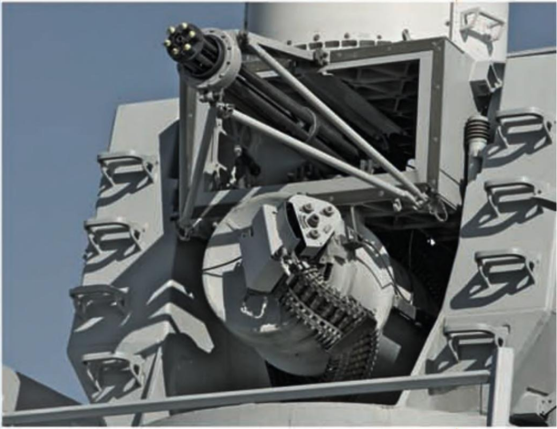
▲ **CHAFF AND DECOY LAUNCHER**
The Super Rapid Bloom Offboard Chaff system launches chaff and infrared decoys to confuse enemy missiles and fire-control systems.



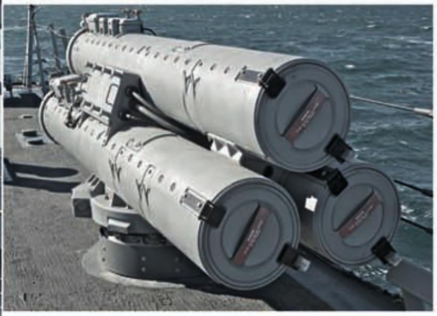
THE WEAPONS SYSTEMS



▲ 25MM CHAIN GUN
Fed ammunition by an electrically operated chain mechanism, two Mk38 guns provide defence against patrol boats or floating mines.



▲ 20MM ROTARY CANNON
The two Phalanx Close-In Weapons Systems use automated radar-controlled cannon to identify, track, and destroy incoming missiles.

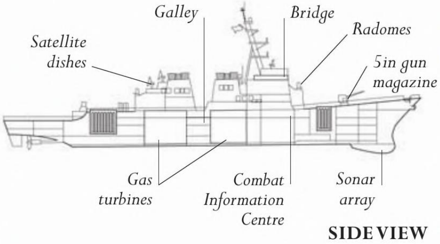


▲ TORPEDO TUBES
There are two sets of Mk32 triple torpedo tubes. The torpedoes are fired using compressed air from a flask at the rear of the tubes.

◄ 5IN GUN
The Mk45 gun is designed for use against surface ships or aircraft, or for shore bombardment.

INSIDE AND BELOW DECK

Battle operations are coordinated by the Combat Information Centre (CIC). This is dominated by the computer-based AEGIS combat system, which can simultaneously engage in air, surface, and subsurface warfare. Steel bulkheads are located throughout the ship in case a hit is suffered, and vital equipment is also protected by Kevlar shields. An air filtration system helps to guard against nuclear, biological, and chemical attack.



POWER PLANT

▲ GAS TURBINE
The four LM2500 gas turbines, derived from the engines used on jets such as the Boeing 747, give a top speed of over 30 knots.

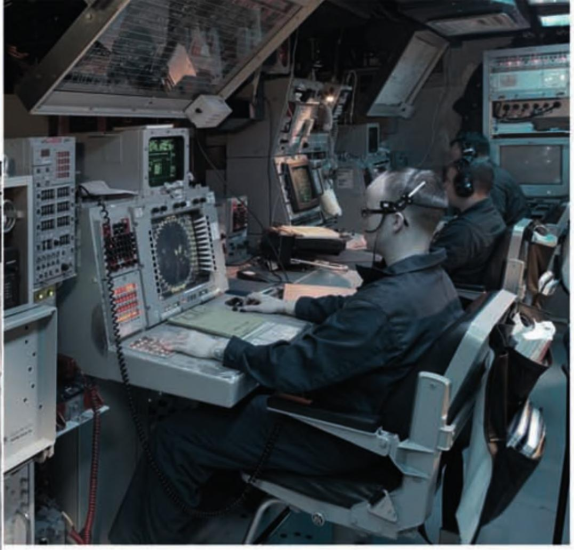
▲ MAIN ENGINE ROOM
Two purification systems, one in each of the two main engine rooms, remove solid contaminants and water from the fuel supply.

CONTROL AND COMBAT

▲ SHIP'S BRIDGE
The helmsman steers from the helm station in the centre of the bridge. There is also an automated digital steering system that allows a course to be entered and automatically maintained.

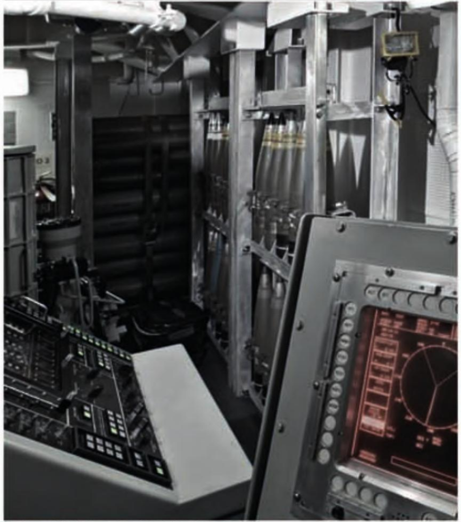
▲ MAIN PASSAGEWAY
Double-plated bulkheads and interior airlock doors provide protection and allow vital areas – such as the turbine control room at the end of the passageway – to be isolated in the event of an attack.

▲ HATCH
Airtight hatches separate the ship into zones to protect against contamination by biological or chemical agents.

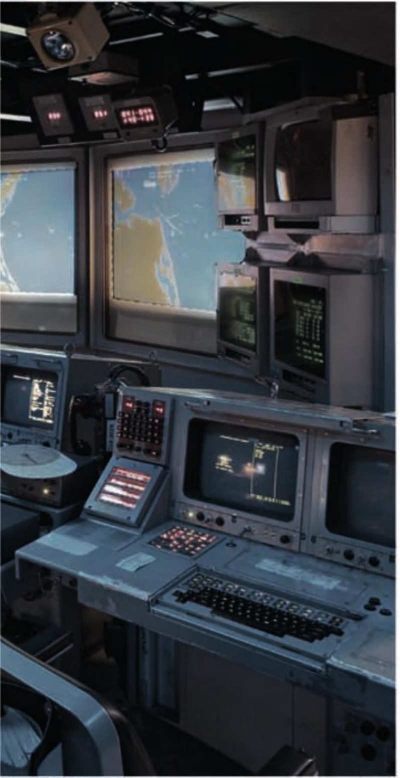


▲ TACTICAL COORDINATOR
A group of specialists staff the CIC, each of whom has a specific role. For example, the Tactical Information Coordinator seen here handles tactical data coming in from allied ships.

AMMUNITION SYSTEM

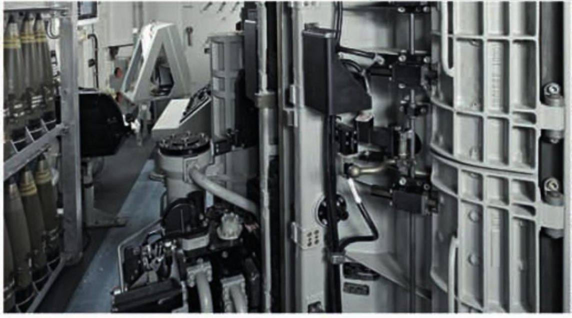


◄ AMMUNITION LOADING SYSTEM
In combat situations, a small team in the 5in gun magazine operates a computerized loading system. The system ensures that there is an uninterrupted supply of ammunition to the Mk45 gun on the deck above.

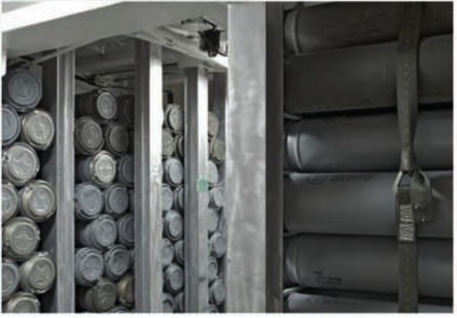


◄ BATTLE ROOM
Based in the CIC, the AEGIS combat system controls and coordinates the ship's weapons and its electronic countermeasures devices.

◄ CIC SCREEN
AEGIS integrates and displays data from radar, sonar, and satellite systems. The AN/SPY 1-D phased array radar can track hundreds of different targets simultaneously.



▲ 5IN GUN MAGAZINE
Situated beneath the Mk45 gun mounting, the *Donald Cook*'s 5in shell magazine stores 680 rounds of ammunition. The yellow markings on the shells indicate that they are high-explosive rounds.

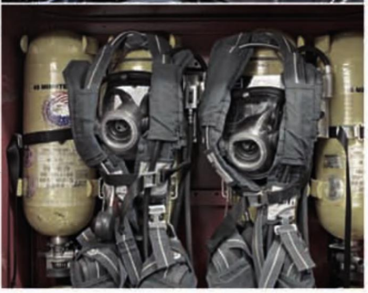


▲ PROPELLANT STORE
The propellant powder used to fire shells from the Mk45 gun is also stored in the magazine. The gun discharges up to 20 rounds per minute.

LIFE ON BOARD

▲ SHIP'S GALLEY
The spacious and well-equipped kitchens on board the *Donald Cook* allow the ship's galley staff to prepare three hot meals a day, with a choice of dishes, for the crew of more than 330 officers and enlisted men and women.

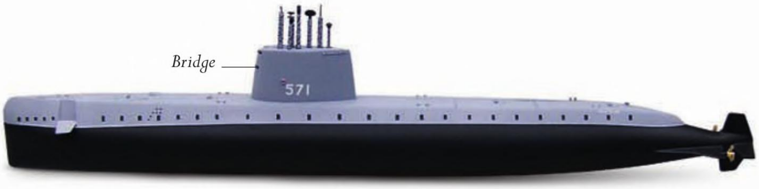
◄ MESS TABLES
Enlisted crew members eat in an informal self-service canteen next to the ship's galley.



◄ FIREFIGHTING GEAR
Fire stations with hoses, protective overalls, and breathing apparatus are located around the decks.

POST-WAR SUBMARINES

Nuclear-powered submarines and their armament of submarine-launched ballistic missiles (SLBMs) are arguably the most potent weapon system ever developed. Hidden beneath the waves, they are able to launch their deadly missiles without warning and are virtually immune from retaliatory action by the enemy. Their high level of concealment also provides them with an invaluable second-strike capability. More conventional attack submarines, powered either by nuclear reactors or diesel-electric motors, operate against surface vessels or hunt down other submarines.



▲ USS NAUTILUS (SSN-571)

Commissioned 1954 **Origin** US

Displacement 3,535 tons (4,090 tons submerged)

Length 98.8m (324ft)

Top speed 22 knots (25 knots submerged)

A ground-breaking vessel, the *Nautilus* was the world's first operational nuclear-powered submarine and, in 1958, the first to complete an underwater transit of the North Pole.

▼ USS MARYLAND (SSBN-738)

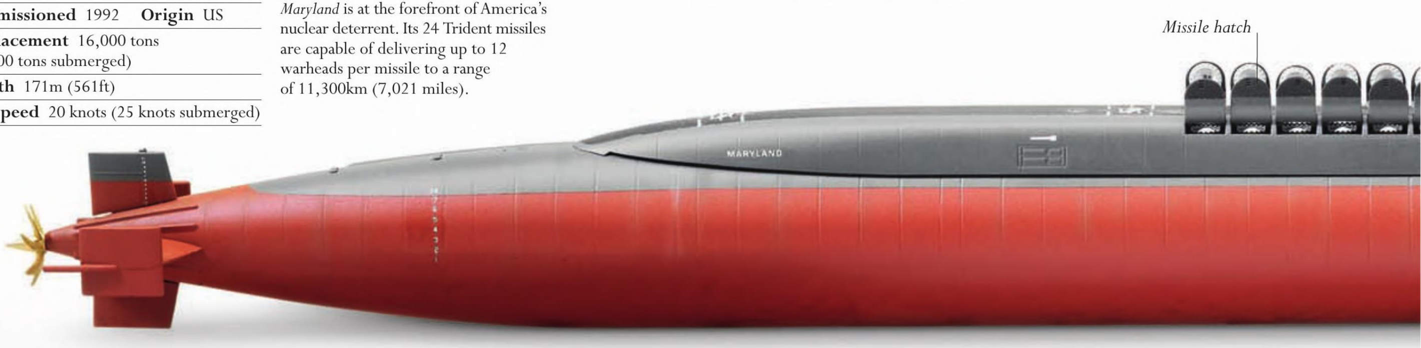
Commissioned 1992 **Origin** US

Displacement 16,000 tons (18,700 tons submerged)

Length 171m (561ft)

Top speed 20 knots (25 knots submerged)

An *Ohio*-class ballistic missile submarine, *Maryland* is at the forefront of America's nuclear deterrent. Its 24 Trident missiles are capable of delivering up to 12 warheads per missile to a range of 11,300km (7,021 miles).



▶ NOVOSIBIRSK (B-401)

Commissioned 1984

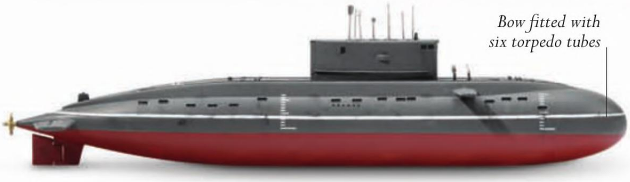
Origin Soviet Union

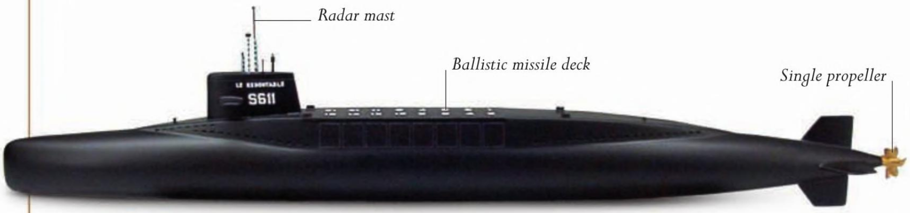
Displacement 2,325 tons (3,075 tons submerged)

Length 67m (220ft)

Top speed 15 knots (24 knots submerged)

A diesel-electric attack submarine of the *Kilo* class, *Novosibirsk* was armed with minelaying equipment and conventional torpedoes, as well as anti-ship and anti-aircraft missiles.


Bow fitted with six torpedo tubes



◀ LE REDOUTABLE (S611)

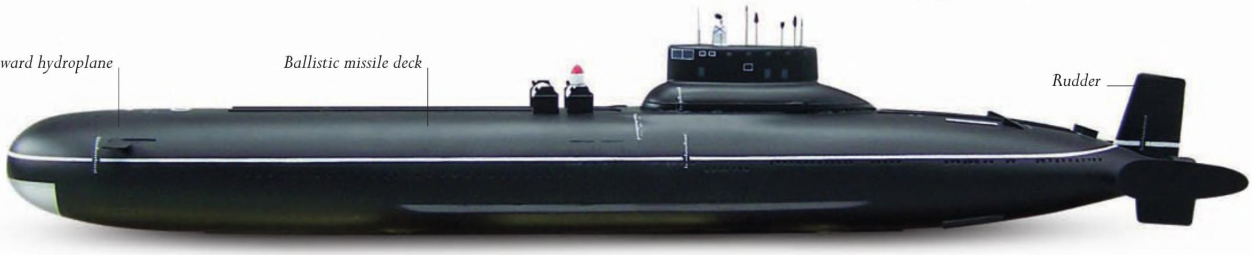
Commissioned 1971 **Origin** France

Displacement 8,045 tons (8,940 tons submerged)

Length 128m (420ft)

Top speed 18 knots (25 knots submerged)

Le Redoutable was the lead vessel in its class and France's first ballistic missile submarine. Its original M1 missiles had a range of 2,000km (1,243 miles) while carrying a 450 kilotonne warhead.



▲ AKULA CLASS

Commissioned 1981

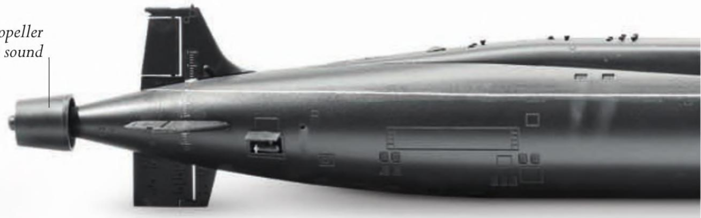
Origin Soviet Union

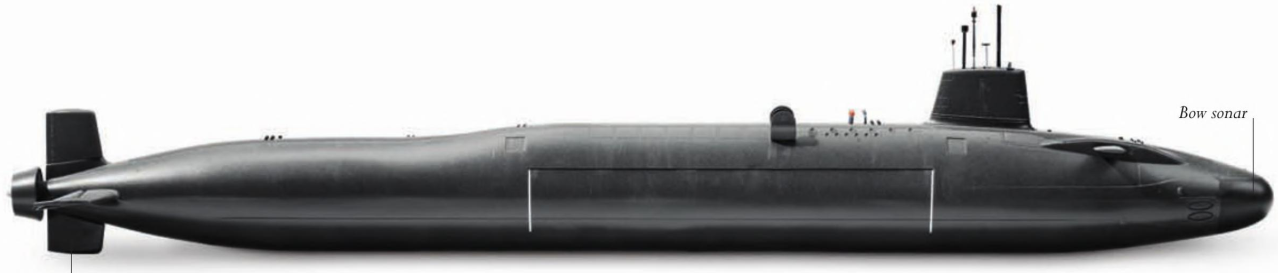
Displacement 18,500 tons (25,000 tons submerged)

Length 175m (574ft)

Top speed 22 knots (27 knots submerged)

Codenamed Typhoon by NATO, the Russian *Akula* ("shark") class of submarines were the largest undersea vessels ever built. They were designed to fire SLBMs while hidden under the Arctic ice.


Shrouded propeller to minimize sound


Bow sonar
Lower fin segment

▲ HMS VANGUARD (S28)

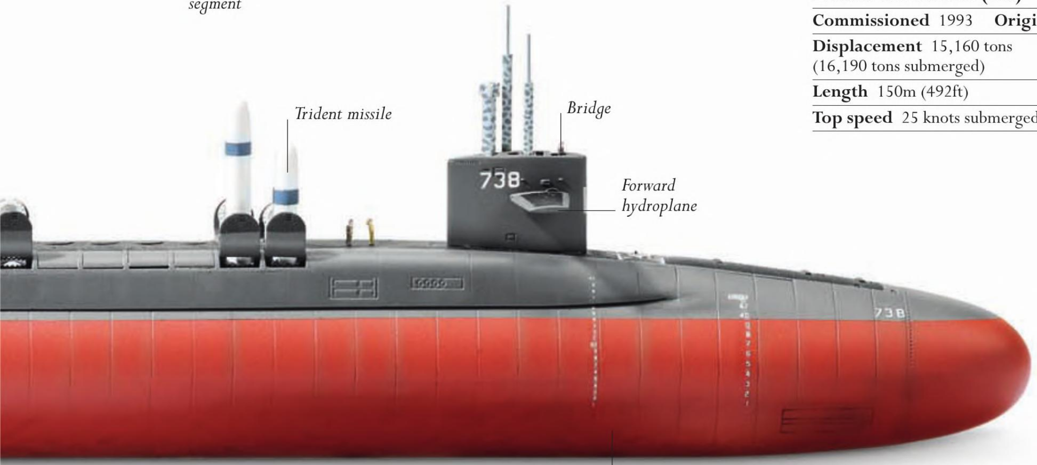
Commissioned 1993 **Origin** UK

Displacement 15,160 tons (16,190 tons submerged)

Length 150m (492ft)

Top speed 25 knots submerged

The lead vessel of its class, the nuclear-powered *Vanguard* is armed with 16 Trident SLBMs, each containing up to 12 warheads. It also has four tubes for Spearfish guided torpedoes.


Trident missile
Bridge
Forward hydroplane
Pressurized hull

▼ LE TRIOMPHANT (S616)

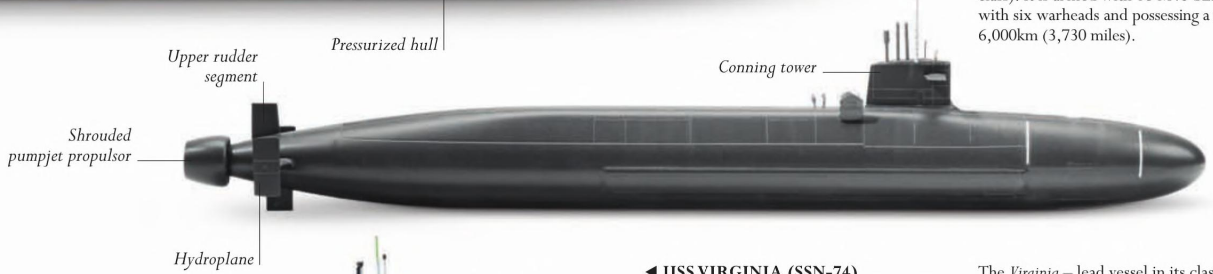
Commissioned 1997 **Origin** France

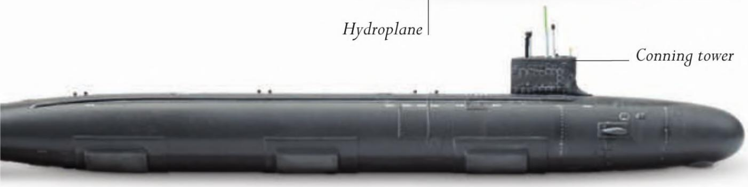
Displacement 12,640 tons (14,335 tons submerged)

Length 138m (453ft)

Top speed 20 knots (25 knots submerged)

Le Triomphant is the lead vessel of its class (a replacement for the French navy's *Redoutable* class). It is armed with 16 M45 SLBMs, each with six warheads and possessing a range of 6,000km (3,730 miles).


Upper rudder segment
Conning tower
Shrouded pumpjet propulsor
Hydroplane


Conning tower

◀ USS VIRGINIA (SSN-74)

Commissioned 2004 **Origin** US

Displacement 6,455 tons (7,101 tons submerged)

Length 115m (377ft)

Top speed 25 knots (32 knots submerged)

The *Virginia* – lead vessel in its class – is a nuclear-powered attack submarine, armed with Mark 48 guided torpedoes and Tomahawk cruise missiles. It features a pressure chamber that can release SEAL divers while submerged.

▶ HMS ASTUTE (S119)

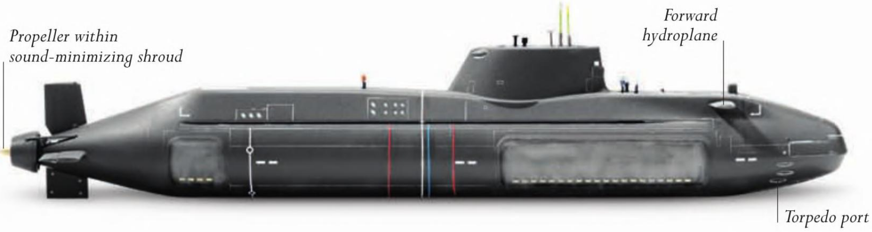
Commissioned 2010 **Origin** UK

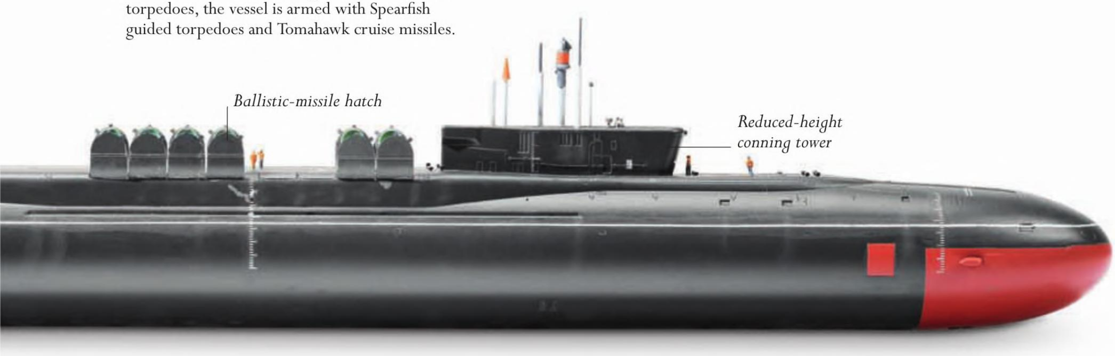
Displacement 7,130 tons (7,535 tons submerged)

Length 97m (318ft)

Top speed 20 knots (30 knots submerged)

A nuclear-powered attack submarine, *Astute* is the lead vessel of its class. Along with conventional torpedoes, the vessel is armed with Spearfish guided torpedoes and Tomahawk cruise missiles.


Propeller within sound-minimizing shroud
Forward hydroplane
Torpedo port


Ballistic-missile hatch
Reduced-height conning tower

◀ YURI DOLGORUKI

Commissioned 2012 **Origin** Russia

Displacement 14,490 tons (23,620 tons submerged)

Length 170m (558ft)

Top speed 15 knots (29 knots submerged)

One of the latest *Borey*-class nuclear-powered submarines, the *Yuri Dolgoruki* is armed with 16 RSM-56 Bulava SLBMs, each missile containing six warheads with a range of up to 10,000km (6,214 miles).

COUNTERINSURGENCY

COMBAT IN AFGHANISTAN

The soldiers of the International Security Assistance Force (ISAF) operating against Taliban insurgency in Afghanistan had access to the most advanced military technology available in the early 21st century. But as Operation Moshtarak showed in February 2010, this still left infantrymen vulnerable.

Operation Moshtarak was a large-scale offensive into a Taliban-controlled area of Helmand Province in southern Afghanistan. Some 15,000 American, British, Canadian, and Afghan army troops were sent in to wrest control of the area in order to disrupt poppy cultivation and drug-trafficking networks, and install government rule. The insurgents were hiding among the local population and occupying the towns of Marjah and Showal.

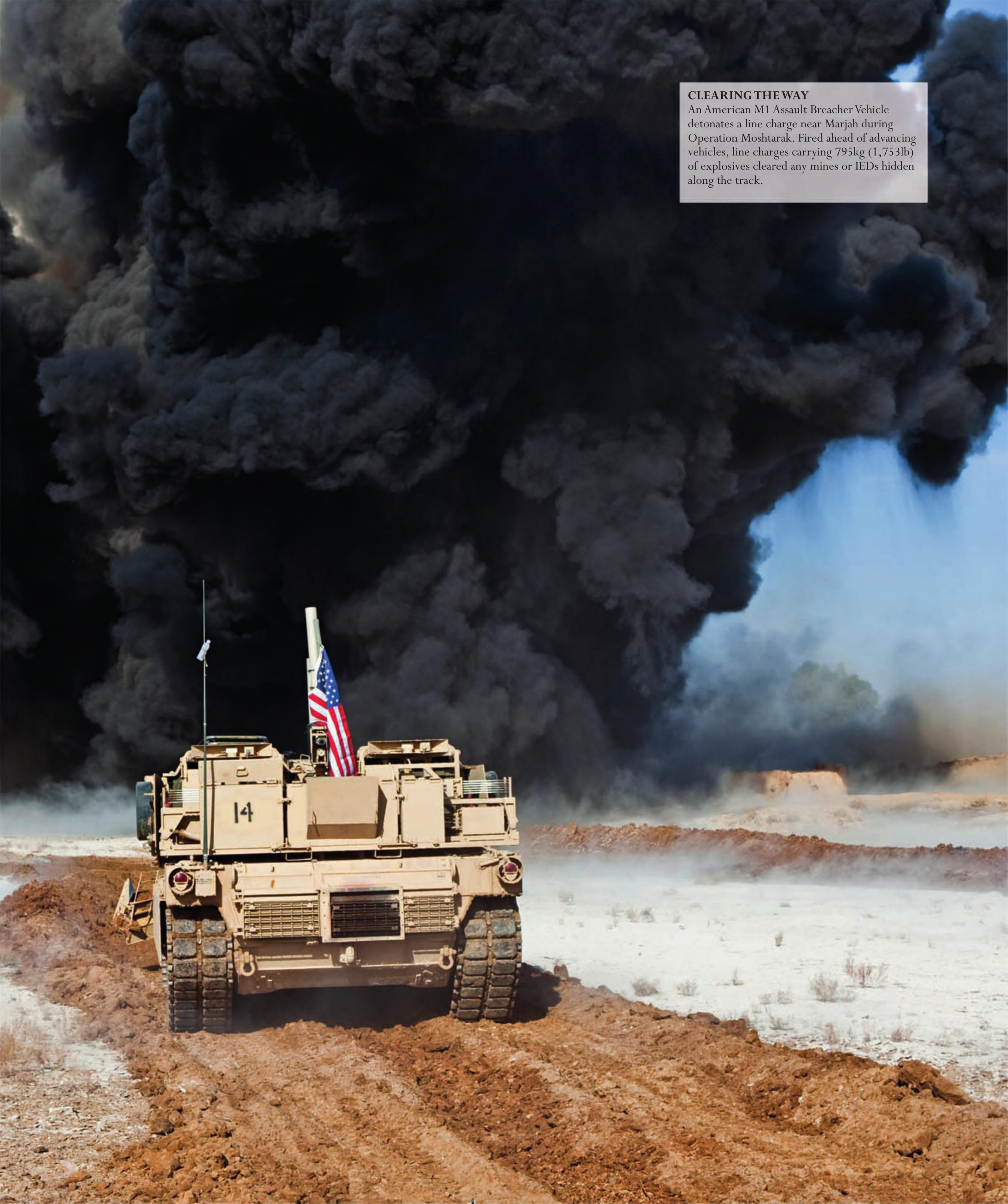
Equipped with the latest night-vision optics, the ISAF was able to launch the operation under cover of darkness. Small special forces units that had infiltrated the target area – British SAS and US Navy SEALs – called in strikes by Predator unmanned aerial vehicles (UAVs) and Apache attack helicopters against Taliban positions. About two hours before dawn, Super Stallion and Chinook helicopters, escorted by helicopter gunships, airlifted troops to landing sites near the target towns. The soldiers advanced with caution across ground scattered with improvised explosive devices (IEDs), the cause of two-thirds of ISAF casualties in Afghanistan. Using portable aluminium bridges, they were able to cross the numerous irrigation ditches without traversing existing bridges that would inevitably be mined. While the airlifted troops approached the Taliban-held towns, other US forces began advancing from their bases overland into Taliban territory. M1 Assault Breacher Vehicles led the way along the heavily mined and booby-trapped roads; occasionally line charges (rockets towing cables of plastic explosive) were fired ahead to blow up any concealed devices.

The opening day of the operation was impressively efficient and successful, with pockets of Taliban resistance smartly overcome. US Marines established themselves inside Marjah and British troops entered Showal. Most Taliban forces had probably left by this stage, but sufficient insurgents remained in the towns to pose a serious threat. The typical Taliban armoury of AK assault rifles, RPG-7 rocket-propelled grenade launchers, PK machine guns, and bolt-action sniper rifles was a match for ISAF infantry weapons in an environment that offered plentiful concealment.

WAR AMONGST THE PEOPLE

Clearing the town house by house was a demanding task. The obvious tactic for the Americans and British, eager to keep their own casualties low, was to identify the buildings occupied by Taliban elements and call in air strikes or use surface-to-surface missiles to destroy them. Modern guidance systems ensured that specific targets could be hit with a high degree of accuracy most of the time, but there was still a grave risk of politically undesirable civilian casualties. Indeed, on the second day of the operation, two missiles fired by an American High Mobility Artillery Rocket System (HIMARS) – a truck-mounted multiple rocket launcher – killed 12 Afghans in Marjah, including children.

Although the main towns were officially under Afghan government control within 12 days of the start of the operation, draining low-level combat continued, with sniper fire and IEDs imposing a steady toll on ISAF and Afghan soldiers. In time, the outcome would prove inconclusive.



CLEARING THE WAY
An American M1 Assault Breacher Vehicle detonates a line charge near Marjah during Operation Moshtarak. Fired ahead of advancing vehicles, line charges carrying 795kg (1,753lb) of explosives cleared any mines or IEDs hidden along the track.

GLOSSARY

Adze An axe-like weapon on which the blade is at a right angle to the shaft.

Afterburner A component in a jet engine that burns additional fuel with the exhaust gases to increase thrust.

Aileron A hinged surface on an aircraft's wing that controls the aircraft's horizontal orientation.

Armet A helmet developed in 15th-century Europe.

Arquebus A *muzzle*-loading firearm used between the 15th and 17th centuries, which was a forerunner of the 18th-century *musket*.

Arrestor wire A cable used on aircraft carriers to decelerate an aircraft as it lands on deck.

Assault rifle A *magazine*-fed automatic *rifle* that uses an *intermediate cartridge*.

Automatic weapon A firearm that will load and fire continually when the trigger is pressed.

Auxiliaries Additional troops that support the main body of an army; troop support of any kind.

Aventail A curtain of mail that covers the neck and shoulders.

Ballista A Roman missile weapon designed for siege warfare.

Barb A spar on an arrowhead that makes it difficult to remove the arrow once it is embedded.

Barbette An armoured structure protecting a cannon or artillery piece.

Barbuta A visorless steel helmet, which was a form of *sallet*, first produced in the 15th century.

Bardiche An Eastern European staff weapon with a long, cleaver-type blade.

Barding Armour for horses.

Baselard A late-medieval short sword.

Basinet A medieval helmet worn with a visor.

Battalion A military unit of between 300 and 1,200 soldiers.

Battery A group of artillery weapons – usually four to eight.

Battlecruiser A class of heavily armed ship developed as a type of fast *battleship* in the years before World War I.

Battleship The largest type of armed ship in a fleet.

Bayonet A blade designed to fit into, over, under, or around the *muzzle* end of a firearm, enabling it to be used as a close-combat weapon.

Besagew A round plate of armour used to protect the armpit. Also known as a *rondel*.

Blunderbuss A *muzzle*-loading firearm with a short, flared *muzzle*.

Bolt action (rifle) A firearm with a manually operated bolt that, in one action, extracts a spent *cartridge* case and chambers a fresh one.

Bore The internal diameter of a gun barrel – traditionally the number of rounds it was able to take that could be cast from 454g (1lb) of lead.

Bow The front of a ship or a boat.

Breech The rear part of the *bore* of a firearm or artillery piece.

Brigade Three infantry or tank *battalions*.

Brigandine A type of medieval body armour made of small metal plates riveted to a textile covering.

Broadside The simultaneous discharge of some or all of the guns on one side of a warship.

Bullpup A type of *rifle* with a firing mechanism set back in the shoulder *stock*, allowing for a normal-length barrel in a relatively short weapon.

Burgonet An open-faced helmet used widely in the 16th century.

Butt The part of a *rifle* held to the shoulder; the part of a pistol held in the hand.

Calibre The internal diameter of a weapon's barrel; also used to describe specific cartridge types.

Capital ship The most powerful class of warship in a navy.

Carbine A short-barrelled *rifle* or *musket*, typically of a smaller *calibre* than the *rifle*, first designed for cavalry.

Carrack A three- or four-masted sailing ship developed in Europe in the 15th century.

Carronade A short-barrelled, short-range cannon developed by Carron Ironworks, Scotland, c.1770.

Cartridge The package that contains the projectile and propellent used by a firearm.

Casemate A fortified structure designed as a shelter for troops; an artillery enclosure on a warship.

Catapult (aircraft carrier) A track-and-piston system used to launch aircraft from the deck of an aircraft carrier.

Chaff Pieces of metal or plastic released into the air – usually by aircraft – to disrupt enemy radar.

Chain gun A *machine-gun* that loads and fires *cartridges* via an externally powered chain, rather than recoil.

Chamber The part of a firearm from which the *cartridge* is fired.

Chape See *scabbard*.

Chasseur A French light infantry, or light cavalry, soldier trained for rapid action.

Coaxial gun A secondary tank armament, used alongside the primary long gun.

Composite bow A bow made of multiple layers, combining wood with bone, horn, or sinew.

Corbel An arched stone structure supporting the higher parts of a castle's walls.

Corps A military group of two to three divisions.

Corvette A small, lightly armed ship.

Couter A plate or piece of articulated armour that protects the elbow.

Crenel An open space or notch in a battlement or wall.

Crinet Armour that protects a horse's neck.

Crossbow A mechanical bow that shoots wooden or metal bolts.

Crossguard See *quillons*.

Cuirassier A cavalryman named after the metal breast- and back-plate (or "cuirass") that he wore.

Cuisse Medieval armour that protected the thigh.

Dao A Chinese weapon with a single edge, used for slashing.

Destroyer A fast, lightly armoured vessel armed with guns and anti-submarine weapons.

Dirk A dagger traditionally used by naval officers.

Discharger cup A cup fixed to the end of a *rifle* to accept grenades or missiles for firing.

Dragoon A military unit trained to fight on horseback or on foot.

Dreadnought A turbine-powered *battleship* class naval craft armed with heavy guns of uniform *calibre*.

Drone A remotely piloted aircraft typically used for reconnaissance.

Electronic countermeasure An electronic device designed to disrupt enemy radar or sonar.

Elevator A hinged surface on an aircraft's wing that controls the aircraft's vertical orientation.

Elevon A control surface on an aircraft's wing that combines the functions of an *aileron* and an *elevator*.

Elliptical wing An aircraft wing design that minimizes drag.

Enfilade Gunfire directed at an enemy's flank.

Escort carrier A merchant ship converted during World War II to carry aircraft. It carried 6–35 aircraft, far fewer than the larger *fleet carrier*.

Extractor The moving part of a firearm that removes spent casings from the *chamber* after firing.

Falconet A type of light medieval cannon.

Fauld A skirt of armour that protects the waist and hips.

Field gun Artillery designed to be portable rather than fixed.

Firestep A step built or cut into the wall of a trench to allow soldiers to fire over the edge.

Firing pin The part of a firing mechanism used in certain firearms and explosive devices to detonate the charge.

First-rate ship The designation used by the British Royal Navy for the largest ships of the line, its smaller vessels being classed as second- or third-rate.

Flanchards Armour to protect a horse's flanks.

Flash suppressor/hider A device that reduces the flash caused by gasses burnt on firing a gun.

Fleet carrier An aircraft carrier intended to operate with the main fleet of a navy.

Flintlock A firing mechanism in which a flint strikes a steel surface, creating sparks that ignite the charge.

Frigate An 18th- or 19th-century warship with two full decks; a 20th-century warship with anti-submarine capability.

Fuller A groove cut into a blade to make it lighter.

Fulminate A type of explosive that is sensitive to shock.

Fuselage The main body of an aircraft.

Galleon A square-rigged, three-masted sailing ship in use between the 16th and 18th centuries.

Gauntlets Armoured gloves.

Gimbal A device that keeps a ship's compasses horizontal despite the ship's movements.

Glaive A European staff weapon consisting of a single-edged blade attached to the end of a pole.

Gorget An armoured collar designed to protect the throat.

GPMG General-purpose *machine-gun*.

Greave Armour that protects the leg from knee to ankle.

Gunport A square hole cut into the side of a sailing warship through which guns are fired.

Half-track A vehicle with wheels at the front and tank-style caterpillar tracks at the back.

Hanger A sword with a short, wide blade, often used at sea.

Hauberk A thigh-length mail coat or shirt.

Head-up display A transparent data screen that can be viewed looking forwards out of an aircraft.

Heavy cruiser A class of warship that is smaller than a *battleship*; its main armament is usually 8in guns.

Heavy machine-gun A *machine-gun* chambered for a round of larger-than-*rifle calibre*, usually 12.7mm; a *machine-gun* fired from a fixed mount.

Hilt The hand-held part of a word, including the grip, guard, and *pommel*.

Horsepower A unit of power equal to the energy required to raise 250kg (550lb) 30cm (1ft) in one second.

Howitzer A high-angle artillery piece used for destroying fortifications and trench systems.

Hydro-pneumatic recoil A recoil system with a gas-charged shock absorber, used in modern, quick-firing mounted guns.

Iklwa A flat-bladed Zulu stabbing spear, also known as an assegai.

Incendiary shell/round A projectile designed to start a fire.

Inertial navigation A high-tech navigation system that uses dead-reckoning to calculate the position of a moving object without requiring external references.

Intermediate cartridge Medium-sized ammunition primarily used in *assault rifles*.

Ironclad A mid-19th-century warship with a hull built from, or protected by, iron plates.

Jian A Chinese sword with a long, straight blade with two edges.

Katana The long sword carried by a *samurai*.

Knot A unit used to measure a ship's speed. One knot equals one nautical mile per hour.

Lamellar A type of armour made of small plates laced together.

Langet A strip of metal secured along the length of a wooden staff weapon to reinforce the wood.

Light cruiser A cruiser typically equipped with 6in guns.

Light machine-gun A *machine-gun* chambered for *rifle-calibre* ammunition, but not capable of sustained fire.

Line of battle The formation of a fleet before entering into battle, traditionally a line.

Limber A simple trailer attached to a gun carriage.

Mace A medieval staff weapon with a spiked or flanged head.

Mach number The ratio of an aircraft's speed to the speed of sound. Mach 2, for example, is twice the speed of sound.

Machicolation An opening in a castle wall through which missiles could be dropped on an invading enemy.

Machine-gun An *automatic weapon* intended for sustained fire.

Machine pistol A pistol capable of automatic or select fire.

Magazine The part of a firearm that holds the ammunition; a storage area for ammunition in a building or on board a ship.

Mangonel A type of medieval siege catapult.

Matchlock A firing mechanism incorporating a piece of cord (or "slow-match") that ignites the *primer* when the trigger is pulled.

Medium machine-gun A *machine-gun* chambered for *rifle-calibre* ammunition and capable of sustained fire.

Mine An explosive laid beneath the surface of the ground or left floating on or just below the surface of the water.

Minesweeper A ship used for clearing *mines* at sea.

Miquelet A type of *snaphaunce* firing mechanism prevalent in the Mediterranean between the late-16th and mid-19th centuries.

Misericorde A long, narrow knife used in medieval times to deliver the "mercy stroke" to a mortally wounded knight.

Morion A 16th-century helmet with a flat or swept brim, and either a comb along its centre line or a "pearstalk" at its apex.

Mortar A high-angle, short-ranged artillery piece.

Muzzle The open front end of a firearm's barrel.

Musket A term originally used for a large and heavy firearm shot from a rest, that, from the 18th century, described a *smooth-bore* longarm gun.

Naginata A Japanese infantry *polearm* with a curved blade.

Optical sight A sighting device providing a single point of aim and often a degree of magnification.

Ordnance The collective term for cannon and artillery.

Orlop deck The lowest deck of a ship.

OSS The Office of Strategic Services, a World War II covert US intelligence service.

Paravane A device towed by a ship to destroy *mines* in the water.

Pennon A banner or streamer borne on a cavalryman's lance.

Percussion cap A firing mechanism with a small cap containing *fulminate* that serves as a primer in *muzzle*-loading firearms.

Phalanx An Ancient Greek military formation of heavy infantry armed with spears.

Pike An infantry weapon with a pointed metal head fixed on a long, wooden shaft.

Plate armour Armour made of articulating metal plates.

Pommel A counterweight at the top of a sword grip.

Pocket battleship A term that was given to three small but heavily armed German cruisers: *Graf Spee, Deutschland,* and *Admiral Scheer*.

Poleyn The part of medieval and Renaissance armour that protected the knee.

Pre-dreadnought A type of *battleship* with mixed heavy and medium main armament.

Primer The small amount of *fulminate* lit by a firing mechanism to ignite the main charge in the barrel; another word for *percussion cap*.

Privateer A private vessel used to raid enemy shipping in war.

Quillons Extended cross-guards on either side of a sword or knife blade designed to protect the hand.

Radar An instrument used to locate an object by transmitting and measuring radio waves.

Rapier Usually a thrusting sword with a long blade.

Rating An enlisted member of a navy.

Repeating rifle A *rifle* that can discharge multiple consecutive shots.

Revolver A gun which carries ammunition in a rotating cylinder.

Rifle A long-barrelled firearm with spiral grooves in the barrel.

Rolling barrage A continuous firing of artillery shells.

Rondel See *besagew*.

Rondel dagger A late-medieval European dagger with a round hand guard, and *pommel*.

Rotary cannon A revolving, multi-barrelled gun that provides a greater rate of fire than a single-barrelled gun of the same *calibre*.

Running rigging The part of a sailing vessel's rigging that controls the movement of the sails.

Sabaton Foot-covering armour.

Sallet A 15th-century helmet featuring a tail to protect the neck.

Samurai A member of military and political aristocracy in pre-industrial Japan.

Sap A deep, narrow trench used to approach or undermine an enemy position.

Sapper A combat engineer.

Scabbard A sword's sheath, terminating in a *chape*.

Scimitar An Islamic sword with a curved blade.

Scramasax See *seax*.

Seax A single-edged blade used by Anglo-Saxons and Franks as both a weapon and a tool.

Shaffron Protective armour for a horse's head.

Shako A tall, peaked hat adorned with a feather or pompom, worn by European and US soldiers.

Shamshir A type of *sabre* that spread from Persia from the 16th century onwards. It has a deep curve and tapers to a point.

Ship of the line A sailing warship, usually of a third-rate class vessel with 74 guns. See also *first-rate ship*.

Shrapnel shell A projectile containing a number of small bullets that explodes just before impact.

Silencer A device that reduces, but rarely silences, the sound, flash, and recoil of a fired round; for this reason, it is also known as a suppressor or moderator.

Skirmisher An infantryman or cavalryman who harasses the enemy in an irregular fashion.

Sloop A sailing vessel with a single mast and fore-and-aft rig; any minor class of warship.

Smart weapon A precision-guided munition directed to its target using laser guidance or GPS.

Smooth-bore A gun barrel lacking a rifled interior.

Snaphaunce An early *flintlock* mechanism featuring a separate pivoting striking surface made of steel, and a sliding pan-cover.

Sonar An electronic device used primarily by submarines to locate underwater objects.

Sponson A semi-circular gun turret on the side of a tank.

Staff weapon A type of weapon mounted on a long wooden or metal haft.

Standing rigging Fixed rigging that supports a ship's sails.

Stock The portion of a firearm that is held by the person firing it; it is attached to the lock, which holds the sparking mechanism, and the barrel, which carries and guides the explosive-driven shot or bullet.

Strakes The long planks forming the hull frame of a Viking longship.

Strategic bombing The planned destruction of specific targets with the intention of weakening the economy of an enemy state and the morale of its people.

Submachine-gun A hand-held *automatic weapon* firing pistol-*calibre* rounds.

Talwar A curved Indian sword.

Tang The part of a sword or knife that extends inside the grip.

Tanto A traditional Japanese short sword or dagger.

Tomahawk A North American Indian axe; a type of US cruise missile.

Tracer bullet A bullet treated with illuminant to show its direction and range.

Trebuchet A siege machine employing either manpower or counterweights to launch missiles.

Trireme An ancient Greek or Roman war galley, propelled by three tiers of oars on each side.

Turbocharger A device that compresses air into the combustion chamber of an engine to increase power and efficiency.

Turtle ship A 16th-century Korean armored warship that was fitted with an iron cover to prevent boarding by the crew of enemy ships.

U-boat (*Unterseeboot*) A German submarine.

Vambrace Armour that was developed in the 14th century to protect the forearm; from the 5th century it was designed to cover the whole of the arm.

Vervelles Metal staples used to attach an *aventail* to a helmet.

Visor A face defence attached to a helmet to protect the eyes.

Volley gun A multi-barrelled gun that fires several rounds at the same time.

Wakizashi A 30–60cm (12–24in) short sword that was worn by *samurai*.

Warhammer A medieval close-combat weapon with a handle of varying lengths.

Warhead The explosive material delivered by a rocket, missile, bomb, or torpedo.

Wheellock The first self-igniting firearm. It featured a friction-wheel that created a spark that lit the charge whenthe trigger was pulled.

Wolf pack A term used for a group of German submarines during World War II.

Yard The wooden spar perpendicular to the mast, from which a ship's sails are hung.

Yari A traditional straight-bladed Japanese spear.

Zeppelin Any of the airships built by the Zeppelin company; a generic term used for airships.

INDEX

A

- Afghanistan
  - Afghanistan medal 259
  - guerrilla warfare 391, 409
  - helicopters 401, 402–03, 408–09, 436
  - International Security Assistance Force 436`
  - Operation Moshtarak 446–47
  - Predator unmanned aerial vehicles (UAVs) 436
  - Second Anglo-Afghan War 259
  - Soviet occupation 391
  - Taliban 409
  - weapons 383, 395, 428, 429, 436–37
- Africa
  - guerrilla warfare 391
  - South Africa *see* South Africa
  - weapons and clothing 252–53
- Agincourt, Battle of 72, 73, 81
- Ain Jalut, Battle of 96–97
- air and sea battles, 1914–45 342–43
- aircraft
  - airships 300, 343
  - helicopters *see* helicopters
  - nuclear bombers and interceptors 386–87
  - predator drones (UAVs) 408, 409, 428, 436
  - strategic bombing 300–01
- aircraft, France
  - Dassault Mirage 2000D 411
  - Dassault Mirage III C 387
  - Dewoitine D.520 307
  - Voisin 8 304–05
- aircraft, Germany
  - AEG G.IV 304
  - airships 300
  - Albatros D.V 302
  - Arado Ar 234B-2 313
  - Dornier DO.17 310–11
  - Eurofighter Typhoon 410–11
  - Fieseler FI.156 Storch (Stork) 320
  - Focke-Wulf FW 190 Würger (Shrike) 306–07
  - Focke-Wulf FW 200 Condor 320–21
  - Fokker Dreidecker 303
  - Fokker D.VII 302–03
  - Fokker Eindecker 302
  - Gothas heavy bombers 301
  - Heinkel HE 111 310
  - Heinkel HE 177 Grief (Griffin) 312
  - Junkers JU 52/3M 320
  - Junkers JU 87 Stuka 301
  - Junkers JU 87D Stuka 312
  - Messerschmitt BF 109 fighter 301
  - Messerschmitt BF 110 306
  - Messerschmitt ME 163 Komet (Comet) 309
  - Messerschmitt ME 262 Schwalbe (Swallow) 300, 308–09
  - Zeppelin Staaken 305
- aircraft, Italy, Eurofighter Typhoon 410–11
- aircraft, Japan
  - Kawasaki KI-100 309
  - Mitsubishi A6M Zero 346–47
  - Nakajima KI-43 Hayabusa "Oscar" 307
  - Yokosuka MXY7 Okha 313
- aircraft, Russia/Soviet Union
  - Ilyushin IL-2 "Shturmovik" 307
  - Mikoyan-Gurevich MIG-15 410
  - Mikoyan-Gurevich MIG-21R 414
  - Mikoyan-Gurevich MIG-25 "Foxbat" 387
  - Sikorsky "Ilya Mourometz" 304
  - Sukhoi Su-27 "Flanker" 411
  - Tupolev TU-95 "Bear" 386–87
  - Yakovlev Yak-3 308–09
- aircraft, Spain, Eurofighter Typhoon 410–11
- aircraft, UK
  - Airco D.H.9A "Ninak" 305
  - airships 343
  - Airspeed Horsa glider 321
  - Avro 504K 302
  - Avro 698 Vulcan B2 386
  - Avro Lancaster 310–11
  - BAE Harrier II GR9A 410
  - Bristol Fighter F.2b 303
  - De Havilland Mosquito B.16 T12–13
  - English Electric Lightning F.1A 386–87
  - Eurofighter Typhoon 410–11
  - Fairey Swordfish "Stringbag" 342, 346
  - Gloster Gladiator 306
  - Gloster Meteor 308
  - Handley-Page Halifax MK II 311
  - Hawker Hurricane 306–07
  - Hawker Tempest Mk II 308
  - RAF F.E.2 304
  - RAF R.E.8 "Harry Tate" 304
  - S.E.5A 302
  - Short S.25 Sunderland 321
  - Short Stirling MK I 311
  - Sopwith Pup 303
  - Supermarine Seafire 347
  - Supermarine Spitfire 306–07
  - Vickers Vimy 304–05
  - Vickers Wellington 310
  - Westland Lysander 320
- aircraft, US
  - B-25 Mitchell 310
  - B-29 long-range bombers 300, 301
  - Boeing B-17 Flying Fortress *see* Boeing B-17 Flying Fortress
  - Boeing B-29A Superfortress 313
  - Boeing B-47 Stratojet 386
  - Boeing B-52 Stratofortress 386
  - Boeing E-3A Sentry (AWACS) 414–15
  - Boeing E-6B Mercury 415
  - Consolidated B-24 Liberator 310–11
  - Consolidated PBY Catalina 320
  - Convair B-58 Hustler 387
  - Curtiss P-40 Warhawk 307
  - Curtiss SB2C Helldiver 342, 346
  - Douglas A-20 Havoc 313
  - Douglas C-47 Skytrain 320–21
  - Douglas SBD Dauntless 343, 346
  - General Dynamics Fighting Falcon 410
  - Grumman E-2C Hawkeye 415
  - Grumman F-14 Tomcat 424
  - Grumman F4F Wildcat 346
  - Grumman F6F Hellcat 347
  - Grumman F8F Bearcat 347
  - Grumman OV-1 Mohawk 414
  - Lockheed F-117 Nighthawk stealth aircraft 412–13
  - Lockheed Martin F-35A Lightning II 411
  - Lockheed P-3C Orion 414
  - Lockheed SR-71 Blackbird 414–15
  - Lockheed U-2A 414
  - McDonnell Douglas F-15C Eagle 386–87
  - Martin B-26 Marauder 312
  - Mitchell B-25 bomber 300–01
  - MQ-9 Predator drone 428
  - North American F-86 Sabre 410
  - North American P-51 Mustang 308
  - Northrop P-61 Black Widow 309
  - Predator UAV 409, 429
  - Reaper UAV 429
  - Republic P-47 Thunderbolt 308
  - RQ-4 Global Hawk UAV 428
  - Sentinel stealth UAV 428
  - Sikorsky R-4 Hoverfly 321
  - Vought F4U Corsair 347
- aircraft carriers 342–45
  - American *Enterprise*, USS 345
  - American *Essex*, USS 345
  - American *George Washington*, USS 424–27
  - American *George Washington*, USS *see George Washington*, USS
  - American *Guadalcanal*, USS 345
  - American *Lexington*, USS 343
  - American *Saratoga*, USS 343, 344
  - American *Yorktown*, USS 343
  - British *Argus*, HMS 342–43
  - British *Ark Royal*, HMS 344
  - British *Furious*, HMS 342, 344–45
  - British *Hermes*, HMS 343
  - British *Illustrious*, HMS 344–45
  - Japanese *Akagi* 344
  - Japanese *Hosho* 343
  - Japanese *Shinano* 329
  - strike aircraft 346–47
  - *see also* ships
- Aisne, Battle of the 286
- Akkadians 15
- al-Qaeda 428
- Alexander the Great 24, 25
  - Gaugamela, Battle of 25, 28
  - Issus, Battle of 28–29
- Algeria, invasion by France 240
- American Civil War 218
  - Antietam, Battle of 232–33
  - Gettysburg, Battle of 220, 221
  - ironclad ships 260–61
  - Mobile Bay, Battle of 260–61
  - railways and electric telegraph 221
  - Spencer carbine Model 1865 rifle 228
  - uniforms 234–35
  - weapons 220–21, 228, 236–37, 246–47, 261
- American Revolutionary War 160
  - Continental Army 161, 174–75, 222
  - Saintes, Battle of the 197
  - uniforms 172–73, 174, 175
  - weapons 172–73, 175, 222
  - Yorktown, Battle 158, 161
- amphibious operations
  - DUKW ("Duck") truck 326
  - Leyte Gulf, Battle of 348–49
  - Normandy landings 340–41
- Ancient Egypt 14, 15, 22–23
  - *see also* Egypt
- Ancient Greece 12
  - armour and weapons 24, 26–27, 29
  - Gaugamela, Battle of 25, 28
  - hoplites and phalanxes 24–27
  - Lelantine War 25
  - Leuctra, Battle of 25
  - Marathon, Battle of 24, 25
  - Peloponnesian War 24–25
  - Salamis, Battle of 24
  - trireme 30–31
- Anglo-Dutch Wars, Texel, Battle of 149
- Anglo-Saxons
  - Hastings, Battle of 58–59
  - weapons and armour 56–57
- Ankara, Battle of 91
- Antietam, Battle of 232–33
- Arab and Turkish conflict 90–91
  - *see also* Muslims; Ottoman Empire
- armour
  - Almain rivet 120
  - Ancient Egypt 15
  - Ancient Greece 24, 26–27, 29
  - Anglo-Saxons 56–57
  - Assyrian empire 18
  - cavalry (17th century) 128–29
  - Chinese medieval 146–47
  - Crusader 95
  - elephant 136
  - full plate 126
  - helmets *see* helmets
  - Iranian 92–93
  - Japanese medieval 102–03, 142–43
  - Middle Ages 60–65, 68, 74
  - Middle East 92–93
  - Mongol 98–99, 101
  - Mughal 130, 136–37
  - Norman 56–57
  - Osprey Body Armour 419
  - Ottoman Empire 132–33
  - pre-Columbian 108–09
  - Russian 418
  - Spanish *tercio* 120
  - Viking 50, 52–53
- armoured vehicles
  - American Dodge T214 light truck 361
  - American GMC 2½-ton 6x6 truck 360–61
  - American M3A1 scout car 360
  - American M5 half-track 361
  - American T17E1 Staghound 353
  - American Willy's jeep 360–61
  - British Rolls-Royce car 294–95
  - German *Schwimmwagen* (amphibious vehicle) 361
  - German SDKFZ 251-8 AUSF C half-track 360
  - Rolls-Royce armoured car 294–95
  - *see also* tanks
- arquebus 116, 122–23
  - armour, ineffectiveness against 126
  - *Galera Real* war galley 150
  - initial use of 87
  - Japan, adopted by 138
  - Mohacs, Battle of 114, 134–35
  - Osaka castle, Siege of 146–47
  - *see also* matchlocks
- Arras, Battle of 276, 292–93
- arrowheads *see* bows and arrows
- Asian traditions 42–43
  - East Asia conflict 138–39
  - East Asian warfare 96–97
- Assyrian empire 12, 15, 18, 19
  - Lachish, Siege of 20–21
  - Til Tuba, Battle of 15
- Austerlitz, Battle of 159, 182–83, 212
- Australia
  - *Perth*, HMAS (cruiser) 334–35
  - Vietnam Medal 407
- Austria
  - astrolabe 202
  - Austrian Succession, War of 160
  - *Galera Real* (war galley) 150–53, 154
  - Jena-Auerstadt, Battle of 182
  - machine-gun, Schwarzlose M07/12 282
  - muskets 190
  - pistols *see* pistols, Austria
  - rifles *see* rifles, Austria
  - Siege of Vienna 131
- Avro
  - 504K 302
  - 698 Vulcan B2 386
  - Lancaster 310–11
- axes
  - Chinese *guandao* 142
  - Congolese 253
  - Danish bearded 74
  - English bill 74
  - *francisca* throwing 41
  - French boarding 208
  - French pollaxe 74–75
  - hand (ancient) 16, 17
  - Mamluk 92
  - Maori ceremonial *toki* 253
  - Mayan 108
  - medieval double-handed 58–59
  - Russian bardiche 75
  - Scottish 75
  - trench axe (WWI) 290
- Aztec Empire 110–11, 114
  - flower wars 106–07
  - weaponry 108–09, 111, 116

B

- Baker rifle 192–93, 222
  - sword bayonet 165, 193
  - Waterloo, Battle of 194–95
  - *see also* rifles
- battering ram 20–21
- Bayernwald trench 286–87
  - *see also* World War I
- Bayezid I, Sultan 90, 91
- bayonets
  - Arras, Battle of 292
  - Baker rifle sword 165, 193
  - cavalry swords 236–37
  - double-barrelled flintlock with 169
  - Egg's carbine 165
  - Elcho 237
  - "Ersatz" knife 291
  - Indian tiger 165
  - James II inscription on 164
  - MLE 1866 Chassepot 236–37
  - plug 164–65
  - socket 160, 161, 165
  - *see also* muskets
- Belgium
  - machine-guns *see* machine-guns, Belgium
  - pistols *see* pistols, Belgium
  - rifle, FN FAL Prototype assault 392
- Bergmann
  - LMG15NA machine-gun 284–85
  - MP18/I machine-pistol 285
  - No.3 pistol 255
- bicycles, BSA folding 375
- Bin Laden, Osama 428
- Blake, Admiral Robert 149
- Bodiam Castle, England 84–85
- Boeing
  - AH-64 Apache helicopter 402–03
  - B-17 Flying Fortress 300–01, 314–17
  - B-29A Superfortress 313
  - B-47 Stratojet 386
  - B-52 Stratofortress 386
  - bomb sight computer 317
  - chain gun 402
  - E-3A Sentry (AWACS) 414–15
  - E-6B Mercury 415
  - "fire-and-forget" capacity 402
  - Hellfire missiles 402
  - Vertol CH-47 Chinook helicopter 400–01
- Boer Wars 219, 241
  - concentration camps 257
  - Queen's South Africa medal 259
  - scorched earth policy 257
  - smokeless gunpowder 257
  - Spion Kop 240
  - weapons 256–57, 288
- bombs and missiles
  - American AEGIS 423, 445
  - American atomic bombs 319
  - American FIM-92 Stinger missile 395
  - British Mills Bomb, No. 36 291
  - German A4 (V2) 319
  - German Blohm & Voss BV246 Hagelkorn 318
  - German Fiesler Fi103 (V1) 318–19
  - German Henschel HS 117H Schmetterling 318
  - German Ruhrstahl X-4 AAM 319
  - German Ruhrstahl/Kramer X-1 ("Fritz-X") 318
- Bouvines, Battle of 68–69

- bows and arrows
  - Assyrian Empire 19
  - bodkin arrows 77
  - crossbows *see* crossbows
  - Hunnish bow 41
  - Japanese 103
  - longbow 72–73, 77, 80–81
  - Mughal 137
  - Norman arrows 57
- Breitenfeld, Battle of 115, 126–27
- Bren gun 369
- Browning
  - automatic rifle (BAR) M1918 284–85
  - Colt-Browning Model 1895 "potato digger" machine-gun 245
  - GP35 pistol 366–67
  - HP35 pistol 404
  - M2 HB machine-gun 369
  - M2 machine-guns 315, 317
  - M1917 machine-gun 283
  - M1919 machine-gun 368–69
- Burma, war elephants 139
- Byzantine Empire 50, 60
  - Dyrrhachium, Battle of 61
  - "Greek Fire" weapon 51
  - Manzikert, Battle of 90

C

- Canada
  - Timberwolf C14 sniper rifle 420–21
  - *Vancouver* (frigate) 423
- cannon
  - American Dahlgren gun 261
  - bombards 86, 89
  - British Armstrong RML 12-pounder 239
  - British Blomefield pattern 24-pounder 198–99
  - British Maxim QF 1-pounder "Pom-Pom" 245
  - British muzzle-loading 12-pounder 199
  - Chinese 18-pounder 238
  - Chinese 32-pounder 239
  - Chinese iron 103
  - Chinese silk gun 143
  - Congreve rockets 182, 183, 201
  - English, cast-iron 3-pounder 199
  - English bronze falcon 118–19
  - English bronze saker 118
  - Flanders bronze demi-cannon 119
  - Flanders Mons Meg 89
  - Fontenoy, Battle of 170–71
  - French bronze demi-culverin 119
  - French bronze robinet 118–19
  - *Galera Real* war galley 150–51
  - German Krupp 218, 221
  - Italian, bronze minion 118
  - Japanese hand cannon 142–43
  - Malaysian bronze saker 119
  - Middle Ages 48, 82, 86, 88–89
  - naval 198–99
  - Ottoman Empire 91, 130, 131, 148
  - rammer and sponge 199
  - rifled 238–39
  - rotary 431
  - Russian licorne 238–39
  - Scottish Carron 200–01
  - slow matches 198
  - swivel guns 89, 201
- Carthage, Punic Wars 33
- cavalry
  - armour and weapons 128–29
  - charge 127
  - dragoons, introduction of 127
  - Fontenoy, Battle of 170–71
  - lance, abandonment of 126–27
  - Middle Ages 49, 51, 58–61, 68
  - Roman 33
  - swords and bayonets 236–37
- chariots, horse-drawn 15
- Charlemagne 50, 51
- Chile
  - *Almirante Simpson* (torpedo gunboat) 272
  - Steyr "Hahn" M1911 pistol 255
- China
  - Anglo-French invasion 240
  - axe, *guandao* 142
  - Boxer rebellion 240
  - cannon *see under* cannon
  - crossbows 96
  - Great Wall 97, 104–05, 138
  - guerrilla warfare 390
  - gunpowder 86, 96, 97, 138
  - Liaohsi Medal 406
  - Manchu Banner system 138–39
  - matchlock gun 143
  - medieval armour 146–47
  - Mongol conquest of 48
  - naval power, early 96, 97
  - Opium Wars 240
  - Red Cliffs, Battle of the 42
  - rifles *see* rifles, China
  - swords *see* swords, China
  - Terracotta Army 43, 44–45
  - tribal warfare 43, 96
- Churchill, Winston 326
  - Omdurman, Battle of 219, 251
- Cold War 382–85
  - ballistic missiles 384–85
  - guerrilla warfare 390–91
  - hydrogen bomb tests 384
  - limited warfare, practice of 385
  - Mutually Assured Destruction (MAD) doctrine 385
  - NATO formation 384
  - nuclear arms race 382, 384, 385
  - Vietnam War *see* Vietnam War
  - Warsaw Pact 384
- Colt
  - Colt-Browning Model 1895 "potato digger" machine-gun 245
  - Dragoon revolver 220
  - Frontier double-action 227
  - Lightning 227
  - M1902 255
  - M1911A1 366
  - Navy Model 1851 225
  - New Service 290
  - Paterson revolving rifle 224–25
  - pocket pistol model 1849 224
  - SAA ("Peacemaker") 226
- communications
  - modern warfare 408–09
  - naval conflict (18th century) 202–03
  - radio direction-finding equipment ("huff-duff") 327
  - railways and electric telegraph 221
  - suitcase radio 350, 376
  - World War I 298–99
  - World War II 322–23
- Constantinople, Siege of 86–87, 91
- contemporary era *see* modern warfare
- Courtrai, Battle of 72
- Crécy, Battle of 73, 80–81
- Crimean War
  - Charge of the Light Brigade 220
  - electric telegraph 221
  - ironclad ships 260
  - sea mines 261
  - Turkish Crimean medal 258
  - Victoria Cross 258
  - weapons 220, 221, 236–37
- Cromwell, Oliver 127
- crossbow *see also* bows and arrows
- crossbows 58, 72–73, 77, 78–79
  - ballista 88
  - "Big Joe" 377
  - China 96
- Crusades 60, 61
  - Hattin, Battle of 90–91
  - Krak des Chevaliers castle 82, 83
  - Siege of Acre 83
  - swords and armour 94–95
- Cumberland, Duke of 170, 192

D

- Dacian Wars 36–37
- daggers
  - Celtic 40–41
  - English ballock ("kidney") 76
  - English quillon 76
  - English rondel 76
  - flint 16–17
  - German Landsknecht 121
  - Indian *katar* 137
  - Italian stiletto 178
  - Japanese *tanto* 103, 141
  - *see also* knives
- Darius III of Persia 28–29
- Dassault
  - Mirage 2000D aircraft 411
  - Mirage III C aircraft 387
- Denmark, bearded axe 74
- *Donald Cook*, USS 430–33
  - chain gun 431
  - helicopter launch pad 430
  - rotary cannon 431
  - weapon systems 421, 430, 432, 433
- Douglas
  - A-20 Havoc 313
  - C-47 Skytrain 320–21
  - McDonnell Douglas F-15C Eagle 386–87
  - SBD Dauntless 343, 346
- Drake, Sir Francis 148

E

- East India Company 166–67, 230–31
- Egypt
  - Ain Jalut, Battle of 96–97
  - Ancient 14, 15, 22–23
  - Mamelukes 96, 97, 131
- England
  - Agincourt, Battle of 72, 73, 81
  - Anglo-Saxons *see* Anglo-Saxons
  - Battersea shield 40
  - bayonets 164–65
  - bill (axe) 74
  - boatswain's call 203
  - cannon *see under* cannon
  - Civil War 116, 127, 129
  - daggers *see under* daggers
  - Gravelines, Battle of 148
  - Halidon Hill, Battle of 72
  - Hastings, Battle of 50–51
  - Hundred Years' War 61
  - longbowmen 72, 77
  - Marston Moor, Battle of 127
  - *Mary Rose* (carrack) 77, 149
  - mortar, Coehoorn 178
  - naval supremacy (17th century) 149
  - pistol, John Waters blunderbuss 210
  - Rouen, Siege of 82
  - swords *see* swords, England
  - uniforms 57, 116, 163, 210–11
  - *see also* Scotland; UK
- Ethiopia 241
  - Ethiopian Congo Medal 406
- Europe
  - Imperial Wars 240–41
  - infantry armour (16th century) 120–21
  - naval warfare (16th century) 148–49
  - naval warfare (19th century) 196–97
  - permanent armies (18th century) 158
  - siege warfare (18th century) *see* siege warfare
  - star forts (16th century) 117
  - uniforms (18th century) 160–61, 163
  - weapons (16th century) 116–17, 120–21, 126–27
  - weapons (18th century) 160, 161

F

- Fairey Swordfish "Stringbag" 342, 346
- Falklands War 395, 422
  - South Atlantic Medal 407
- field guns
  - American M1A1 gun 370–71
  - breech-loading artillery 248–49
  - British 9-pounder 239
  - British 18-pounder QF Mark II 288
  - British, Armstrong RBL 40-pound 248
  - British BL 15-pounder 7cwt 248
  - British Blakely RML mountain gun 239
  - British mountain guns 288–89
  - British Whitworth 3in boat gun 248
  - French 6-pounder 179
  - French 12-pounder "Voltaire" 179
  - French 75 221
  - French bronze three-barrelled 178
  - French Canon de 75mm Modèle 1897 249
  - French Hotchkiss quick-firing 3-pounder naval gun 249
  - German 7.58cm light mortar new model 289
  - German 7.7cm Sockel-flak 289
  - German Feldkanone 96 neuer Art 7.7cm 249
  - German Krupp 8.9cm 249
  - German Nebelwerfer 41 371
  - gunner's callipers and dividers 178
  - howitzers 288–89, 370, 371
  - hydro-pneumatic recoil system 249
  - Indian 6-pounder 178, 238–39
  - rifled (19th century) 238–39
  - Russian M1938 field howitzer 370
  - Russian M1942 field/anti-tank gun 359
- Fieseler
  - Fi103 (V1) missile 318–19
  - FI.156 Storch (Stork) aircraft 320
- Finland, Lahti L39 anti-tank rifle 358
- firearms *see* field guns; flintlocks; matchlocks; muskets; pistols; rifles
- Flanders
  - Bayernwald trench 286–87
  - Bouvines, Battle of 68–69
  - cannon *see under* cannon
  - Fontenoy, Battle of 170–71
  - Namur, Siege of 158, 177, 180–81
- Fleurus, Battle of 182
- flintlocks
  - adoption of 160
  - double-barrelled with bayonet 169
  - Dutch double-barrelled 200–01
  - French carbine Model AN IX 190–91
  - French Charleville Modèle 1777 184
  - light dragoon carbine 168–69
  - replacing matchlocks 117, 122
  - smoothbore 194–95
  - swivel gun 201
  - on *Victory*, HMS 215
- flower wars 106–07
- Fokker
  - Dreidecker 303
  - D.VII 302–03
  - Eindecker 302
- Fontenoy, Battle of 170–71
- France
  - Agincourt, Battle of 72, 73
  - aircraft *see* aircraft, France
  - Algeria invasion 240
  - AMX-13 tank 416
  - artillery reform (Gribeauval) 161
  - Butterfield sundial 202
  - cannon *see under* cannon
  - Chappe telegraph system 182
  - Chateau Gaillard 83
  - Courtrai, Battle of 72
  - Croix de Guerre medal 324
  - Duchy of Normandy, formation of 51
  - field guns *see under* field guns
  - flintlocks *see under* flintlocks
  - Franco-Prussian War 218, 220, 221, 236–37
  - Grand Alliance 177, 181
  - helicopter, SA Gazelle 401
  - Hundred Years' War 61
  - Ivry, Battle of 127
  - Légion d'Honneur 259
  - Louis XIV wars 176, 177, 180–81
  - machine-guns *see* machine-guns, France
  - Marignano, Battle of 116–17, 127
  - Namur, Siege of 158, 177, 180–81
  - Napoleonic Wars *see* Napoleonic Wars
  - Nine Years' War 176, 177, 180–81
  - Novara, Battle of 117
  - Pavia, Battle of 117
  - pistols *see* pistols, France
  - Revolution *see* French Revolutionary Wars
  - rifles *see* rifles, France
  - Rouen, Siege of 82
  - ships *see* ships, France
  - siege warfare 176
  - swords *see* swords, France
  - tanks *see* tanks, France
  - trench knife 291
  - uniforms 160, 184–85, 231, 281
- Franks 50, 51
- Frederick the Great 160, 161, 163
- French Revolutionary Wars
  - armies and conscription 182–83
  - Fleurus, Battle of 182
  - Nile, Battle of the 159, 196, 206–07
  - reconnaissance balloon 182
  - uniforms 184–85
  - Valmy, Battle of 183
  - weapons 184, 190–91, 208, 209

G

- Gatling gun 220
- Gaugamela, Battle of 25, 28
- Genghis Khan 96, 100–01
- *George Washington*, USS 424–27
  - defence systems 424, 425, 427
  - nuclear reactors 426, 427
- Germany
  - aircraft *see* aircraft, Germany
  - armour 64–65, 121, 128–29
  - armoured vehicles 360, 361
  - bayonet, "Ersatz" knife 291
  - BMW R75 motorcycle combination 360
  - bombs and missiles 318–19, 327, 409
  - cannon, Krupp 218, 221
  - "caracole" manoeuvre against pike squares 126–27
  - crossbow 78–79
  - Crusader sword 94–95
  - Eastern Front Medal 325
  - field guns *see under* field guns
  - halberd 120
  - helicopter, Messerschmitt-Bölkow-Blohm BO-105 400
  - knife, airborne gravity 375
  - knight's sword 70–71
  - Kursk, Battle of 351
  - Landsknechte foot soldiers 116
  - Landsknecht dagger and sword 121
  - Lechfeld, Battle of 51
  - machine-guns *see* machine-guns, Germany
  - Magdeburg, Sack of 177
  - Magyar defeat 51
  - mortar, 50mm light M36 370
  - naval supremacy, race for 261
  - Operation Market Garden 372–73
  - pike 75
  - pistols *see* pistols, Germany
  - Pour le Mérite (Blue Max) medal 324

  - rifles *see* rifles, Germany
  - ships *see* ships, Germany
  - stick grenade 290
  - storm troopers 279, 280
  - swords *see* swords, Germany
  - tanks *see* tanks, Germany
  - terrorism and Red Army Faction 391
  - uniforms 121, 362
- Gravelines, Battle of 148
- Greece *see* Ancient Greece
- grenades
  - American M67 "baseball" 397
  - American XM25 launcher 428
  - British Mills Bomb, No. 36 291
  - German stick 290
  - launcher, Individual Airburst Weapon System (IAWS) 429
  - South African Milkor MGL launcher 395
  - *see also* bombs and missiles; mortars
- Grumman
  - E-2C Hawkeye 415
  - F-14 Tomcat 424
  - F4F Wildcat 346
  - F6F Hellcat 347
  - F8F Bearcat 347
  - OV-1 Mohawk 414
- Guernica 300
- guerrilla warfare
  - Afghanistan 391
  - Africa 391
  - Boer War 256–57
  - modern-day 382, 390–91, 409
  - Vietnam War 390, 398–99
- Gulf War 382, 402–03, 409, 412–13
- gunpowder
  - Baker rifle *see* Baker rifle
  - China 86, 96, 97, 138
  - and fortifications 84, 86–87
  - matchlock musket 122–23
  - Middle Ages 48, 82, 86
  - smokeless 257
- Gustavus Adolphus of Sweden 126, 127

H

- Hadrian's Wall 36, 37, 38–39
- Hastings, Battle of 58–59
- Hattin, Battle of 90–91
- Hawker
  - Hurricane 306–07
  - Tempest Mk II 308
- Heckler & Koch
  - G41 assault rifle 393
  - MP5 machine-gun 391, 404–05
  - MP7 machine-guns 405
  - PSG-1 sniper rifle 421
- Heinkel
  - HE 111 aircraft 310
  - HE 177 Grief (Griffin) 312
- helicopters 400–01
  - American Bell AH-1 Cobra 400
  - American Bell UH-1 Iroquois 391, 400
  - American Boeing AH-64 Apache *see* Boeing AH-64 Apache helicopter
  - American Boeing Vertol CH-47 Chinook 400–01, 408–09
  - American Sikorsky UH-60 Black Hawk 401, 428
  - British Apache AH Mk1 401
  - French SA Gazelle 401
  - German Messerschmitt-Bölkow-Blohm BO-105 400
  - Soviet MIL MI-24 Hind 401
  - *see also* aircraft
- helmets
  - American US Army advance combat 419
  - American US Marine Corps lightweight 419
  - British Brodie 362
  - bronze 40–41
  - Corinthian 26
  - Crusades, *heaume* 95
  - desert camouflage 418
  - English triple-barred pot 129
  - Flemish cuirassier's 128
  - German burgonet 121
  - Italian comb morion 121
  - Japanese 103, 144–45
  - knights' 66–67
  - Mamluk 93
  - Moctezuma's 109
  - Mughal 136
  - Norman 57
  - Persian parade 92
  - Prussian *Pickelhaube* 231
  - Spanish capacete 74
  - Sutton Hoo 56
  - tank crew (WWI) 294
  - Turkish *chichak* 132
  - *see also* armour; uniforms
- Henry VIII 118–19, 120, 121
- Hideyoshi, Toyotomi 139
- Hiroshima and Nagasaki 300, 313, 319, 378–79, 384
- Hittites 14, 15
- Holy League fleet
  - *Galera Real* war galley 150–53
  - Lepanto, Battle of 148, 154–55
- Hotchkiss
  - Modèle 1914 machine-gun 283
  - quick-firing 3-pounder naval gun 249
- Hundred Years' War 61, 72, 80–81, 86–87
- Hussites 86, 87

I

- Inca Empire 106, 107, 114
- India
  - British rule, rebellion against 240
  - field guns 178, 238–39
  - horseback raiders 43
  - India General Service medal 258
  - Indian Mutiny medal 258
  - Kalinga, conquest of 43
  - Mahabharata War 42–43
  - matchlock guns 168, 169
  - Mughal Empire 130, 131, 136–37
  - Punjab medal 258
  - swords *see* swords, India
  - war elephants 42
- Iran, mail and plate armour 92–93
- Iraq War 402–03, 430–33
  - Baghdad bombing 383, 409
  - guerrilla warfare 390, 409
  - Iraq Medal 407
  - Operation Telic 407
- Islam *see* Muslims
- Israel
  - Eitan UAV 428
  - Galil assault rifle 392–93
  - remote-controlled robotic snake 428
  - Soltam Commando mortar 395
- Issus, Battle of 28–29
- Italy
  - Adowa, Battle of 241
  - armour 62, 120
  - bronze minion cannon 118
  - cavalry flag 231
  - Eurofighter Typhoon aircraft 410–11
  - Franchi SPAS shotgun 404
  - heavy field howitzer M 1914/16 289
  - Legnano, Battle of 72
  - machine-guns *see* machine-guns, Italy
  - matchlock, snapping 121
  - Pavia, Battle of 126
  - ships *see* ships, Italy
  - stiletto dagger 178
  - sword 71
  - tank, Carro-Veloce L3-33 Flamethrower 354
  - uniforms 121, 231, 280

J

- Jackson, General Thomas "Stonewall" 232–33
- Japan
  - aircraft *see* aircraft, Japan
  - armour 102–03, 144–45
  - cannon, hand 142–43
  - castle-building 138
  - Gempei Wars 97
  - Guadalcanal, Battle of 351
  - gunpowder 87
  - Hansando, Battle of 138
  - Hiroshima and Nagasaki 300, 313, 319, 378–79, 384
  - Kagoshima, Battle of 248
  - kamikaze suicide tactics 342
  - Leyte Gulf, Battle of 277, 326, 348–49
  - matchlocks 138, 142, 168
  - Meiji Restoration 240
  - Midway, Battle of 343
  - as modern military power (early 1900s) 240
  - Mongol invasion of 97
  - Myongyang, Battle of 138
  - Nagashino, Battle of 87, 115, 138–39
  - Noryang, Battle of 138
  - Order of the Rising Sun 259
  - Osaka castle, Siege of 146–47
  - Pearl Harbor 327, 343
  - peasant foot soldiers 114
  - rifles *see* rifles, Japan
  - Russo-Japanese War 218
  - Samurai warriors 96–97, 138, 144, 146–47
  - Sekigahara, Battle of 138
  - Sengoku Period 138
  - ships *see* ships, Japan
  - staff weapons (16th century) 142–43
  - swords *see* swords, Japan
  - tank, Ha-Go Type 95 light 354
  - Tennoji, Battle of 146
  - Tokugawa shogunate 138, 240
  - Tsushima, Battle of 264–65
  - uniforms 362
- Judean empire, Lachish, Siege of 20–21
- Julius Caesar 32, 33, 36–37
- Junkers
  - JU 52/3M 320
  - JU 87 Stuka 301
  - JU 87D Stuka 312

K

- khaki, introduction of 280–81
- Killiecrankie, Battle of 164
- Kitchener, General (later Lord) Herbert
  - Boer War 256–57
  - Omdurman, Battle of 250–51
- knives
  - American Mk 3 fighting 375
  - American V44 survival 377
  - Aztec flint 109
  - British knuckle-duster, "Middle East" pattern 377
  - German airborne gravity 375
  - Peruvian *tumi* 108
  - Saxon 56
  - serrated flint 16–17
  - *see also* daggers
- Korea 138, 337
  - Liaohsi Medal 406
  - UN Korea medal 406
- Kosovo, NATO Service Medal 407
- Krupp
  - cannon 218, 221
  - field gun 249
  - "Krupp Cemented" steel armour 266
- Kublai Khan 96, 97

L

- Lachish, Siege of 20–21
- Lebel
  - MLE 1886 rifle 229
  - *Modèle* 1892 pistol 227
- Lee-Enfield
  - Mark III ("Smellie") rifle 243
  - No.4 rifle 364–65
  - Pattern 1913 rifle 242–43
  - rifle 242, 251, 257
- Lee, General Robert E. 232–33
- Lee-Metford, rifle 229, 251, 257
- Legnano, Battle of 72
- Leipzig, Battle of 183
- Lepanto, Battle of 148, 154–55
  - *Galera Real* war galley 150–53
- Leyte Gulf, Battle of 348–49
- Lockheed
  - F-117 Nighthawk stealth aircraft 412–13
  - Martin F-35A Lightning II 411
  - P-3C Orion 414
  - SR-71 Blackbird 414–15
  - U-2A 414
- Louis II of Hungary and Bohemia 134–35
- Louis XV of France 171

M

- Maastricht, Siege of 177
- McClellan, General George B. 232–33
- Macedonians
  - Gaugamela, Battle of 25, 28
  - Issus, Battle of 28–29
- maces 99, 133, 633
- machine-guns
  - 19th century 244–45
  - heavy 282–83
  - light 284–85
  - water- and air-cooled 368–69
- machine-guns, Austria, Schwarzlose M07/12 282
- machine-guns, Belgium
  - FN Minimi 394
  - FN P90 404–05
- machine-guns, France
  - De Reffye Mitrailleuse volley gun 244
  - FM Model 1924/29 368
  - Hotchkiss Modèle 1914 283
  - Mitrailleuse rapid-fire gun 220
- machine-guns, Germany
  - Bergmann LMG15NA 284–85
  - DMW LMG08/15 285
  - DWM MG08 282
  - Heckler & Koch MP5 391, 404–05
  - Heckler & Koch MP7 405
  - MG08/18 285
  - MG13 284
  - MG34 369
  - MG42 369
  - MG43 395
  - MP40 367
- machine-guns, Italy
  - Beretta M38/42 367
  - Breda *Modello* 30 368
  - Fiat-Revelli Model 1914 283
- machine-guns, Russia/Soviet Union
  - Degtyarev DSHK 1938 369
  - Maxim M1910 282
  - PKM 394
  - RPG-7V 394–95
  - RPK74 395
- machine-guns, UK
  - Bren gun 369
  - Maxim 220, 240, 245
  - Maxim .45in Gatling-Gardner calibre 244–45
  - Maxim MG08/15 284
  - Maxim Parabellum LMG14/17 284–85
  - Maxim-Nordenfelt Model 1893 245
  - Maxim's 254
  - Sten 351
  - Sten Mark II 367
  - Sten Mk6 377
  - Thompson M1921 ("Tommy Gun") 351, 366–67
  - Vickers "Light Pattern" Model 1908 282
  - Vickers Mk I 368
  - Vickers-Maxim "New Light" Model 1906 282
- machine-guns, US
  - Browning automatic rifle (BAR) M1918 284–85
  - Browning M2 HB 369
  - Browning M1917 283
  - Browning M1919 368–69
  - Colt-Browning Model 1895 "potato digger" 245
  - Gardner 245
  - Gatling 220
  - Lewis gun M1914 284–85
  - M60 396–97
- Magyars
  - Lechfeld, Battle of 51
- Mahabharata War 42–43
- Mahdists 240, 245, 250–51
- Malaysia, bronze saker cannon 119
- Mamluks 90, 92, 93
- Manchu Banner system 138
- Mao Zedong 390, 391
- Maoris *see under* New Zealand
- Marathon, Battle of 24, 25
- Marignano, Battle of 116–17
- Marston Moor, Battle of 127
- matchlocks 116
  - arquebus *see* arquebus
  - bandolier 122–23
  - Chinese 143
  - Indian 168, 169
  - Indore Torador 169
  - Japanese 138, 142, 168
  - Mughal Empire 130
  - revolving 169
  - snapping 121
  - Tibetan *meda* 169
  - White Mountain, Battle of 124–25
- Mauser
  - C96 pistol 254–55
  - GeW'98 rifle 291
  - Infanteriegewehr 98 rifle 242–43, 364–65
  - KAR98K rifle 364
  - M/71 rifle 223
  - M1878 "Zig-Zag" pistol 227
  - M1896 rifles 243
  - Model 71/84 rifle 229
- Maxim
  - M1910 machine-gun 282
  - machine-gun 220, 240, 245
  - QF 1-pounder "Pom-Pom" cannon 245
- medals
  - Afghanistan medal 259
  - Air Crew Europe Star 325
  - Chinese Liaohsi Medal 406
  - Crimea medal 258
  - Croix de Guerre medal 324
  - Ethiopian Congo Medal 406
  - French Légion d'Honneur 259
  - German Pour le Mérite (Blue Max) medal 324
  - Hanoverian Medal for Waterloo 258
  - India General Service medal 258
  - Indian Mutiny medal 258
  - Iraq Medal 407
  - Japanese Order of the Rising Sun 259
  - NATO Service Medal 407
  - Northern Ireland General Service Medal 407
  - Ottoman War medal 324
  - Prussian Iron Cross 324
  - Punjab medal 258
  - Queen's South Africa medal 259
  - Russian Medal for Courage 325
  - Russian Order of the Patriotic War medal 324–25

  - Russian Order of the Red Star 406
  - South Africa medal 259
  - South Atlantic Medal 407
  - Turkish Crimean medal 258
  - UK Distinguished Flying Cross 325
  - UK General Service Medal 406
  - UK Memorial Plaque 324
  - UK Military Cross 324
  - UK Victoria Cross 258
  - UN Korea medal 406
  - US Air Force Distinguished Service Medal 406
  - US Distinguished Service Cross 407
  - US Medal of Honor 259
  - US Purple Heart medal 325
  - Vietnam Medal 407
  - Vietnam Service Medal 407
  - Waterloo medal 258
- Messerschmitt
  - BF 109 301
  - BF 110 306
  - ME 163 Komet (Comet) 309
  - ME 262 Schwalbe (Swallow) 300, 308–09
  - Messerschmitt-Bölkow-Blohm BO-105 helicopter 400
- Mexico
  - pre-Columbian warfare 106–07
  - pre-Columbian weaponry 108–09
- Middle Ages
  - Agincourt, Battle of 72, 73, 81
  - archers 73, 76–77
  - armour 60–65, 68, 73, 74–75
  - Bodiam Castle, England 84–85
  - bombards 86
  - Bouvines, Battle of 68–69
  - cannon 48, 82, 86, 88–89
  - castle fortification 84–85
  - cavalry 49, 51, 58–61, 68
  - counterweight trebuchet 82, 83
  - Courtrai, Battle of 72
  - Crécy, Battle of 73, 80–81
  - crossbow 58, 72–73, 77, 78–79
  - Crusades *see* Crusades
  - gunpowder 48, 82, 86
  - Hundred Years' War 61, 72, 86–87
  - infantry 48, 61, 72–75
  - Knights Templar 60
  - lances 49, 51, 60
  - longbows 72, 73, 80–81
  - mangonel 82
  - sieges 82–83, 88–89
  - war-hammer 60, 61
  - warfare, evolution of 50–51
- Middle East, weapons and armour (11th to 16th centuries) 92–93
- *Mikasa* 266–69
  - guns 266, 268
  - "Krupp Cemented" steel armour 266
  - Tsushima, Battle of 264–66
  - wireless telegraphy 264, 269
- Mikoyan-Gurevich
  - MIG-15 410
  - MIG-21R 414
  - MIG-25 "Foxbat" 387
- missiles *see* bombs and missiles
- Moctezuma II, Emperor 110–11
- modern warfare
  - bomb disposal, remote-controlled 428, 429
  - camouflage 428, 429
  - communication advances 408–09
  - fighter and strike aircraft, modern 410–11
  - frigates and destroyers 422–23
  - Global Position Satellites (GPS) 408
  - high-tech battlefield 428–29
  - infantry uniforms and equipment 418–19
  - infantry weapons 220, 394–95
  - laser weapons 409, 429
  - night-vision devices 409
  - precision-guided ("smart") weapons 408
  - railways and electric telegraph 221
  - Rapier surface-to-air missile 409
  - reconnaissance aircraft 414–15
  - robotic technology 428–29
  - stealth technology 412–13, 430
  - submarines 434–35
  - tanks 416–17
  - technological innovation 220
  - Unmanned Aerial Vehicle (UAV) ("drone") 408, 409
  - *see also* Cold War
- Mohacs, Battle of 114, 134–35
- Mongols 100–01
  - Ain Jalut, Battle of 96–97
  - armour and weapons 98–99, 101
  - China, conquest of 48
  - Golden Horde, defeat of 96
  - Great Wall of China 104
  - gunpowder 101
  - Liegnitz, Battle of 97
  - mangonels 101
  - siege warfare 101
  - steppe horsemen 100–01
  - trebuchets 101
- Montgomery, General Bernard 372–73
- mortars
  - British 179
  - British 4.2in 371
  - British 13in 200
  - English Coehoorn 178
  - German 50mm light M36 370
  - Israeli Soltam Commando 395
  - Medieval 89
  - Swedish 20-pounder 200
  - *see also* bombs and missiles; grenades
- Mosin-Nagent
  - carbine M1944 365
  - M91 "3-line" 242–43
  - M1891/30PU 364–65
- motorcycles, BMW R75 combination 360
- Mughal Empire 130, 131, 136–37
- muskets
  - Austrian 190
  - bayonets *see* bayonets
  - British Enfield rifled 220
  - British English Sea Service 168–69
  - British India Pattern 190
  - British Minié ball bullet 221
  - carbines 127
  - Charleville 222–23
  - Long Land Pattern "Brown Bess" 168, 175, 188
  - Prussian 1809 pattern 190
  - Turkish snaphaunce (*tüfek*) 169
- Muslims
  - Arab and Turkish conflict 90–91
  - counterweight trebuchet 90
  - Crusades *see* Crusades
  - galley warfare 148–49
  - Hattin, Battle of 90–91
  - Islam, foundation of 48, 90
  - Islamic Empires at war 130–31
  - Islamic shield 93
  - Islamic sword 92
  - Krak des Chevaliers castle 82
  - Manzikert, Battle of 90
  - Poitier (Tours), Battle of 50
  - Reconquista wars 61
  - *see also* Ottoman Empire

N

- Namur, Siege of 158, 177, 180–81
- Napoleon Bonaparte 158, 182, 183
- Napoleonic Wars
  - Austerlitz, Battle of 159, 182–83, 212
  - Grand Armée 182, 183
  - Hanoverian medal for Waterloo 258
  - Leipzig, Battle of 183
  - Nile, Battle of the 159, 196, 206–07
  - Russia, invasion of 182
  - swords 166–67, 208
  - uniforms 184–85, 186, 187, 188–89
  - Waterloo, Battle of 159, 179, 182, 194–95
  - Waterloo medal 258
  - *see also* France
- naval conflict
  - 18th to 19th centuries 200–01
  - 1914–45 326–27
  - evolution to 1914 260–61
  - navigation and communication (18th century) 202–03
  - Paixhans gun 260
  - race for supremacy 261
  - sea mines 261
  - seaplanes replaced by wheeled landplanes 342
  - ships *see* ships
  - torpedoes 261
  - uniforms 210–11
- Nelson, Horatio 196, 197
  - Aboukir Bay, Battle of 207
  - flagships 207, 212–15
  - Nile, Battle of the 159, 196, 206–07
  - Trafalgar, Battle of 196, 197, 199
  - undress coat 211
- Netherlands
  - Anglo-Dutch Wars 149
  - Downs, Battle of the 149
  - Eighty Years' War 117
  - flintlock, double-barrelled 200–01
  - Maastricht, Siege of 177
  - naval supremacy (17th century) 149
  - Operation Market Garden 372–73
  - pistol, M1873 army revolver 226
  - swords *see* swords, Netherlands
- New Zealand
  - *Canterbury* (frigate) 422
  - Maori ceremonial *toki* (axe) 253
  - Maori wars 240
  - Vietnam Medal 407
- Nile, Battle of the 159, 196, 206–07
- Normandy landings 340–41
- Normans
  - Dyrrhachium, Battle of 61
  - weapons and armour 56–57
- Northern Ireland, bomb-disposal robot 429
- nuclear warfare 378–79
  - medals 406–07
  - nuclear-powered submarine 388–89

O

- Oceania, weapons and clothing 252–53
- Omdurman, Battle of 219, 240, 250–51
- Operation Cedar Falls 398–99, 400–01
  - Agent Orange herbicide 401
- Operation Market Garden 372–73
- Operation Moshtarak 446–47
- Operation Neptune Spear 428
- Operation Telic 407
- Opium Wars 240
- Osaka castle, Siege of 146–47
- Ottoman Empire
  - *akinji* scouts and raiders 130
  - Ankara, Battle of 91
  - cannon 91, 130, 131, 148
  - Constantinople, Siege of 86–87, 91
  - galley warfare 148–49
  - Janissaries (elite infantry) 130, 132
  - Lepanto, Battle of 131, 148, 149, 154–55
  - Mohacs, Battle of 114, 134–35
  - Panipat, Battle of 131
  - rifle, miquelet 133
  - rise of 91
  - ships *see* ships, Ottoman Empire
  - Siege of Vienna 131
  - swords *see* swords, Ottoman Empire
  - Timur, defeat by 96
  - weapons and armour 132–33
  - *see also* Muslims
- Otumba, Battle of 110–11

P

- Palestine 391
- Panipat, Battle of 131
- Panzer
  - Kampfwagen II light tanks 354
  - Kampfwagen III medium tank 355
  - Kampfwagen IV medium tank 354
  - Kampfwagen V medium tank 355
  - Kampfwagen VI Tiger I heavy tank 355
  - Kampfwagen VI Tiger II heavy tank 355
  - Panzerbüsche anti-tank rifle 358–59
  - Sturmpanzerwagen A7V tanks 295
- parachutes 375
- Patton, General 350
- Pavise shield 76–77
- Peloponnesian War 24–25
- Peninsular War 192
- Persia
  - Issus, Battle of 28–29
  - Marathon, Battle of 24, 25
  - parade helmet 92
  - Safavids 130, 131
  - swords 19, 40–41
- Peru, *tumi* knife 108
- Phoenician dagger 18
- pikemen 126–27, 128, 146
  - White Mountain, Battle of 124–25
- pistols
  - belt, M1936 363
  - coast guard, pattern 1842 224
  - flare 299
  - flintlock 128
  - machine pistol 284, 285
  - metallic-cartridge 226–27
  - repeater, introduction of 218
  - self-loading 254–55, 366
  - wheellock 87, 126, 127, 129
- pistols, Austria
  - Glock 17 405
  - Rast and Gasser M1898 227
  - Steyr "Hahn" M1911 255
  - Steyr M1905 254–55
  - Steyr SPP 405
- pistols, Belgium
  - Browning GP35 366–67
  - Browning HP35 404
- pistols, England, John Waters blunderbuss 210
- pistols, France
  - heavy dragoon 1747 190
  - holster 191
  - Lebel *Modèle* 1892 227
  - Lefaucheux pin-fire revolver 226
  - sea service (Pattern 1757/1777) 209
- pistols, Germany
  - Bergmann MP18/I machine-pistol 285
  - Bergmann No.3 255
  - Borchardt C93 254–55
  - Luger P'08 285, 290
  - Mauser C96 254–55
  - Mauser M1878 "Zig-Zag" 227
  - Reichsrevolver M1879 227
- pistols, Netherlands, M1873 army revolver 226
- pistols, Russia/Soviet Union
  - PPSH-41 367
  - Smith & Wesson Model 3 226
  - Tokarev TT Model 1933 366
- pistols, Spain
  - Astra M901 366
  - cavalry 224–25
- pistols, UK
  - Adams self-cocking revolver Model 1851 224, 225
  - Deane-Harding Army model double-action pistol 225
  - Gabbett-Fairfax "Mars" 254
  - Kerr double-action revolver pistol 225
  - New Land-Pattern 191
  - Webley & Scott Mk VI 290
  - Webley Model 1910 255
  - Webley-Fosbery 254
  - Welrod silenced 377
- pistols, US
  - Baby Dragoon 224
  - Colt Dragoon revolver 220
  - Colt Frontier double-action 227
  - Colt Lightning 227
  - Colt M1902 255
  - Colt M1911A1 366
  - Colt Navy Model 1851 225
  - Colt New Service 290
  - Colt pocket pistol model 1849 224
  - Colt SAA ("Peacemaker") 226
  - Dragoon 224
  - FP-45 Liberator 377
  - Ingram M10 404
  - M3A1 "Grease Gun" 367
  - Rappahannock 175
  - Remington army Model 1875 226
  - Remington revolver 220
  - Smith & Wesson Model 1 226
  - Smith & Wesson Model 3 226
- Poitiers, Battle of 73, 81
- Poland
  - Klushino, Battle of 127
  - Liegnitz, Battle of 97
  - Operation Market Garden 372–73
- Portugal 168
  - Aljubarotta, Battle of 73
  - Diu, Battle of 149
- Pragmatic Army 170–71
- Prehistoric weapons 16–17
- Prussia
  - Franco-Prussian War 218, 220, 221, 236–37
  - Iron Cross 324
  - Leuthen, Battle of 160
  - musket, 1809 pattern 190
  - rifles *see* rifles, Prussia
  - Seven Weeks' War 221
  - Seven Years' War 160, 168–69, 197
  - uniforms 163, 231
- Punic Wars 32–33

Q

- Quiberon Bay, Battle of 197

R

- Ramesses II 14, 15
- Remington
  - army Model 1875 pistol 226
  - revolver 220
- rifles
  - assault rifle 392–93
  - bolt-action rifle 228
  - breech-loading rifle 218, 220
  - early repeating rifle 228–29
  - heavy dragoon carbine 190
  - laser rifle 429
  - manually-loaded repeater rifle 242–43
  - self-loading rifle 364–65
  - volley gun 201
- rifles, Austria
  - Mannlicher M1895 242–43
  - Steyr AUG "bullpup" assault rifle 393
  - Steyr SSG69 sniper rifle 420–21
- rifles, Belgium, FN FAL Prototype assault rifle 392
- rifles, Canada, Timberwolf C14 sniper rifle 420–21
- rifles, China
  - AK-47 Type 56S assault rifle 392
  - AK-74 assault rifle 393
- rifles, Finland, Lahti L39 anti-tank rifle 358
- rifles, France
  - Berthier MLE 1916 243
  - Chassepot breech-loading rifle 237
  - Chassepot percussion carbine 223

  FAMAS F1 assault rifle 393
  Hecate II sniper rifle 420–21
  Lebel MLE 1886 229
  LeMat Revolver 229
rifles, Germany
  Gewehr 43 365
  H & K G41 assault rifle 393
  H & K PSG-1 sniper rifle 421
  Mauser GeW'98 291
  Mauser Infanteriegewehr 98 242–43, 364–65
  Mauser KAR98K 364
  Mauser M/71 223
  Mauser M1896 243
  Mauser Model 71/84 229
  Panzerbüsche anti-tank rifle 358–59
  Sturmgewehr 44 351, 364–65
  Walther WA 2000 "bullpup" sniper rifle 420–21
rifles, Israel, Galil assault rifle 392–93
rifles, Japan
  Arisaka Meiji 30 243
  pill-lock carbine 143
rifles, Ottoman Empire, miquelet 133
rifles, Prussia
  Dreyse infantry rifle 221
  Dreyse needle gun 220
  Dreyse needle gun Model 1841 222–23
rifles, Russia/Soviet Union
  Dragunov SVD sniper rifle 420–21
  Mosin-Nagent carbine M1944 365
  Mosin-Nagent M91 "3-line" 242–43
  Mosin-Nagent M1891/30PU 364–65
  Tokarev SVT40 365
rifles, Switzerland, Schmidt-Rubin M1889 229
rifles, UK
  Baker *see* Baker rifle
  Boys MK1 anti-tank rifle 358
  Enfield rifled musket 220
  L85A1 (SA80) "bullpup" assault rifle 392–93
  L96A1 sniper rifle 421
  Lee-Enfield 242, 251, 257
  Lee-Enfield Mark III ("Smellie") 243
  Lee-Enfield No.4 364–65
  Lee-Enfield Pattern 1913 242–43
  Lee-Metford 229, 251, 257
  Martini-Henry Mk I 223, 237, 240
  Minié ball bullet 221
  SMLE MkIII 290–91
  Westley Richards "Monkey Tail" carbine 223
rifles, US
  Barrett Model 90 "Bullpup" sniper rifle 420–21
  Browning automatic rifle (BAR) M1918 284–85
  Colt Paterson revolving rifle 224–25
  Colt revolving rifle Model 1855 228–29
  Ferguson 175
  Henry Model 1860 228
  M1 carbine 365, 374
  M1 Garand 350, 351, 364
  M14 396–97
  M16A1 assault rifle 392–93
  M40 sniper rifle 420
  Pennsylvania 172–73
  PHASR laser rifle 429
  Ruger Model 10/22 405
  Spencer 228
  Spencer carbine Model 1865 228
  Spencer repeating carbine 220
  Springfield Trapdoor 223
  Stoner 63 assault rifle 392
  TR3 laser rifle 429
  Winchester carbine Model 1866 228–29
Rolls-Royce armoured car 294–95
Romans 12
  Adrianople, Battle of 33
  Alesia, Siege of 36–37
  Aquae Sextiae, Battle of 33
  Arbeia fort 38–39
  armour 34–35, 36, 40–41
  Battersea shield 40
  Bouvines, Battle of 68–69
  cavalry 33
  Celtic dagger 40–41
  Dacian Wars 36–37
  forts, sieges and roads 36–39
  francisca throwing axe 41
  Gaul, defeat of 33
  Hadrian's Wall 36, 37, 38–39
  Hunnish bow 41
  javelin 35
  Jewish Revolt and Masada fort 37
  Marian reforms 32–33
  Punic Wars 32–33
  sword, *gladius hispaniensis* 32
  Trebia, Battle of 32–33
  weapons 32, 34, 35, 40–41
Russia/Soviet Union
  Afghanistan occupation 391
  aircraft *see* aircraft, Russia/Soviet Union
  bardiche (axe) 75
  body armour 418
  cannon, licorne 238–39
  helicopter, MIL MI-24 Hind 401
  Hotchkiss quick-firing 3-pounder naval gun 249
  Jena-Auerstadt, Battle of 182
  Klushino, Battle of 127
  Kursk, Battle of 351
  machine-guns *see* machine-guns, Russia/Soviet Union
  Medal for Courage 325
  Moscow nuclear bunker 384
  Napoleon invades 182
  Order of the Patriotic War medal 324–25
  Order of the Red Star 406
  pistols *see* pistols, Russia/Soviet Union
  rifles *see* rifles, Russia/Soviet Union
  Russo-Japanese War 218
  see under field guns
  swords *see* swords, Russia/Soviet Union
  T90 MBT tank 417
  tanks *see* tanks, Russia/Soviet Union
  Tsushima, Battle of 219, 264–65, 268
  uniforms 162, 281
  Warsaw Pact 384

S

Safavids 130, 131
Saintes, Battle of the 197
Saladin 91
Scotland
  axes 75
  Bannockburn, Battle of 73
  cannon, carronades 200–01
  Killiecrankie, Battle of 164
  see also England; UK
Seven Years' War 160, 168–69
  "general chase" naval tactics 197
  Quiberon Bay, Battle of 197
  Zorndorf, Battle of 160
Sherman
  Firefly M4 353
  M4A1 medium 352–53
shields
  Ancient Greek 27
  Battersea 40
  Bohemian Pavise 76–77
  chimalli (Aztec) 108–09
  Islamic 93
  Mughal *dhal* 137
  Ottoman *kalkan* 133
  Zulu 252
ships
  aircraft carriers *see* aircraft carriers
  battleships, 19th century 262–63
  capital ships 328–29
  cruisers 334–35
  cruisers, early 270–71
  destroyers and escorts 336–37
  ironclad 260–61
  Paixhans gun 260
  sailing ships and naval combat 159, 196, 206–07, 212–15
  submarines 338–39
ships, Australia, *Perth*, HMAS (cruiser) 334–35
ships, Austria, *Galera Real* (war galley) 150–53, 154
ships, Canada, *Vancouver* (frigate) 423
ships, Chile, *Almirante Simpson* (torpedo gunboat) 272
ships, England, *Mary Rose* (carrack) 77, 149
ships, France
  fireship 148
  La Gloire (battleship) 260
  Le Redoutable (submarine) 434
  Le Triomphant (submarine) 435
  L'Orient (flagship) 206–07
  Médée (frigate) 197
ships, Germany
  Bismarck (capital ship) 329, 346
  Derfflinger, SMS (capital ship) 328
  Dresden, SMS (cruiser) 271
  G37, SMS (destroyer-escort) 336
  Prinz Eugen (cruiser) 335
  Regensburg, SMS (cruiser) 334–35
  torpedo boats 273
  Type VIIC (submarine) 339
  U-9, SM (submarine) 338
  U-25 (submarine) 338
  U-boats 326, 327
  Wilhelm Bauer (submarine) 339
ships, Italy
  Roma (battleship) 409
  Vittorio Veneto (capital ship) 329
ships, Japan
  aircraft carriers *see under* aircraft carriers
  Fuji (battleship) 262–63
  Fuso (battleship) 349
  I-400 (submarine) 339
  Mikasa (battleship) *see Mikasa*
  Mogami (cruiser) 273
  Musashi (battleship) 349
  Seiki (cruiser) 270
  Suzutsuki (anti-aircraft escort) 337
  Takao (cruiser) 270, 335
  Yahagi (cruiser) 335
  Yamashiro (battleship) 349
  Yamato (battleship) 329, 343
ships, Ottoman Empire
  Galera Real war galley 150–53
  Sultana (flagship) 150, 154
ships, Russia/Soviet Union
  Akula class (submarine) 434
  Borodino (battleship) 263, 264
  Novosibirsk (submarine) 434
  Yuri Dolgoruki (submarine) 435
ships, UK
  Acanthus, HMS (corvette) 336
  Adventure, HMS (cruiser) 271
  Agincourt, HMS (destroyer) 337
  aircraft carriers *see under* aircraft carriers
  Astute, HMS (submarine) 435
  Avon Vale, HMS (destroyer-escort) 336–37
  Bellerophon, HMS (battleship) 207
  Captain, HMS (battleship) 262
  Caroline, HMS (cruiser) 334–35
  copper-bottomed 197
  Devastation, HMS (battleship) 262, 260
  Diamond, HMS (destroyer) 422
  Dreadnought, HMS (battleship) 261, 328–29
  E-class submarine 338
  Gibraltar, HMS (cruiser) 270
  Hindustan, HMS (pre-dreadnought battleship) 263
  Holland No. 1, HMS (submarine) 273
  Hood, HMS 329
  Inflexible, HMS (hybrid battleship) 263
  Jackal, HMS (destroyer) 272–73
  Lancaster, HMS (frigate) 422–23
  Leviathan, HMS (cruiser) 271
  Lightning, HMS (torpedo boat) 272
  Mary Rose (flagship) 121
  Mastiff, HMS (destroyer) 273
  Prince of Wales, HMS 326
  Prince of Wales, HMS (battleship) 326
  Queen Mary, HMS (capital ship) 328
  Rattler, HMS (composite gunboat) 270
  Repulse, HMS (cruiser) 326
  Rodney, HMS (capital ship) 329
  Royal Sovereign, HMS (battleship) 263
  Rupert, HMS (rammer) 262
  Sheffield, HMS (destroyer) 422
  Snapdragon, HMS (minesweeper) 336–37
  Sturgeon, HMS (torpedo boat) 272
  T-class (1937–44) submarine 338
  torpedo boats 272
  Vanguard (flagship) 207
  Vanguard, HMS (submarine) 435
  Victory, HMS (flagship) *see Victory*, HMS
  Warrior, HMS (battleship) 260, 262
ships, US
  aircraft carriers *see under* aircraft carriers
  Archerfish, USS (submarine) 329
  Arleigh Burke, USS (destroyer) 423
  Donald Cook, USS (destroyer) *see Donald Cook*, USS
  Gato, USS (submarine) 338–39
  Hazelwood, USS (destroyer) 337
  Herbert J Thomas, USS (destroyer) 422
  Maryland, USS (submarine) 434–35
  Nautilus, USS (submarine) 388–89, 434
  North Carolina, USS (capital ship) 329
  Oliver Hazard Perry , USS (frigate) 423
  Parker, USS (destroyer) 337
  Pharris, USS (destroyer) 423
  Quincy, USS (cruiser) 335
  St. Lo, USS (escort carrier) 349
  Tennessee, USS 327
  Texas, USS (battleship) *see Texas*, USS
  Virginia, USS (submarine) 435
  West Virginia, USS 327
  Yamato, USS (battleship) 343
siege warfare
  bastions, protruding 82, 87, 176
  citadels 176, 181
  development of 176–77
  hornworks 176
  Lachish, Siege of 20–21
  mangonel 88
  medieval castle fortification 84
  ravelins 176
  star fort 176
  traction trebuchet 88
  trenches 177, 181
  weapons 176–77, 181
Sikorsky
  "Ilya Mourometz" 304
  R-4 Hoverfly 321
  UH-60 Black Hawk 401, 428
Smith & Wesson
  Model 1 pistol 226
  Model 3 pistol 226
South Africa
  Boer War *see* Boer War
  Milkor MGL grenade launcher 395
  Queen's South Africa medal 259
  South Africa medal 259
  Zulu wars 240–41, 259
Soviet Union *see* Russia/Soviet Union
Spain
  Aztec Empire *see* Aztec Empire
  Basque separatist movement, ETA 391
  Blenheim, Battle of 160
  capacete (helmet) 74
  Civil War 118, 300, 301
  Downs, Battle of the 149
  Eighty Years' War 117, 176
  Eurofighter Typhoon aircraft 410–11
  fireships 149
  Gravelines, Battle of 148
  Guernica 300
  Incas, defeat of 107, 114
  naval supremacy (16th century) 149
  pistols *see* pistols, Spain
  Reconquista wars 61
  Spanish Armada 115, 148–49
  Spanish Succession, War of 160
  tercios (foot soldiers) 116, 120
Spartans, Peloponnesian War 24–25
spears
  Aztec *atlatls* (spear-throwing sticks) 16, 111
  bone harpoon 17
  German pike 75
  Japanese 142–43
  lance head 63
  lance, medieval 68
  Levallois point 17
  Obsidian spear (Incas) 106
  Saxon 56–57
  Zulu *iklwa* 252–53
Special Forces weapons 404–05
Spion Kop 240
Stamford Bridge, Battle of 58
Süleyman 114, 131, 134–35
Sumerians 14–15, 18–19
sundial, Butterfield 202
Sweden
  Breitenfeld, Battle of 126–27
  Stridsvagn 103 (S-Tank) 416
  Thirty Years' War, involvement in 126, 127
  weapons 89, 200, 243
Switzerland
  Marignano, Battle of 116–17
  Schmidt-Rubin M1889 rifle 229
swords
  18th-century 166–67
  akinakes (Persian sword) 19
  Assyrian *sappara* 19
  Aztec *maquahuitl* 109
  basket hilt 166, 236
  cavalry 166–67
  Crusader 94–95
  double-edged 94–95
  European 70–71
  Flemish bronze gilded 71
  Islamic 92
  Italian 71
  Mughal 137
  naval 204–05, 208, 211
  Norman 56–57
  North African *saif* (*nimcha*) 167
  Pappenheimer 129
  Persian 40–41, 166
  pommel 95
  sickle 41
  sword bayonet 236
  two-handed 75, 121
swords, China
  changdao 142
  dao 140
  jian 103, 141, 166–67
swords, England
  Anglo-Saxon 56, 57
  English 70
  English hand-and-a-half 71
  English short 71
swords, France
  cutlass 205
  French 71
  French Coronation 70
  Model An XIII 187

  Napoleonic infantry 184
swords, Germany
  Crusader 94–95
  knight's 70–71
  Landsknecht 121
  Ulfberht 70–71
swords, India
  moplah 167
  ayudha katti 167
  Nizams' *talwar* (curved sword) 167
swords, Japan
  katana (samurai) 138, 140–41
  tachi 103
  tsuba (hand guards) 141
  wakizashi (samurai) 140
swords, Netherlands
  5-bar hilted 204–05
  S-bar hilted 205
swords, Ottomans
  khanjar 132
  kilic 93, 133
swords, Roman, *gladius hispaniensis* 32
swords, Russia/Soviet Union
  Model 1827 cavalry trooper's 236
  Pioneer Model 1847 236–37
swords, UK
  cavalry trooper's Pattern 1796 190–91
  cavalry trooper's Pattern 1853 236–37
  ceremonial small 204–05
  Dragoon 166–67
  five-ball spadroon 204–05
  infantry hanger 236–37
  midshipman's dirk 210
  mortuary 126, 129
swords, US
  American "foot" officer's 236–37
  American infantry Model 1850 237
  American light cavalry sabre Model 1860 236–37
Syria, Krak des Chevaliers castle 82, 83

T

Taiwan, Penghu, Battle of 139
Taliban *see* Afghanistan
tanks
  anti-tank weapons 289, 358–59, 390, 394
  post-war 416–17
  see also armoured vehicles
tanks, Finland, Lahti L39 anti-tank rifle 358
tanks, France
  AMX-13 416
  Char B1-bis heavy 352
  MILAN anti-tank missile 394
  Renault FT-17 295, 296
  SOMUA S35 352
tanks, Germany
  Flak 36 AA/AT gun 358
  Leopard C2 417
  PAK 36 anti-tank gun 358
  Panzer Kampfwagen II light 354
  Panzer Kampfwagen III medium 355
  Panzer Kampfwagen IV medium 354
  Panzer Kampfwagen V medium 355
  Panzer Kampfwagen VI Tiger I heavy 355
  Panzer Kampfwagen VI Tiger II heavy 355
  Panzerbüsche anti-tank rifle 358–59
  SD. KFZ. 173 Jagdpanther tank destroyer 359
  Sturmpanzerwagen A7V 295
tanks, Italy, Carro-Veloce L3-33 Flamethrower 354
tanks, Japan, Ha-Go Type 95 light 354
tanks, Soviet Union
  T-34 tank 356–57
  T-34/85 medium 353
  T62 416
  T72 416
  T90 MBT 417
tanks, Sweden, Stridsvagn 103 (S-Tank) 416
tanks, UK
  Boys MK1 anti-tank rifle 358
  Challenger 1 MBT 417
  Cromwell, Cruiser Mk VIII (A27M) 352–53
  "Little Willie" 294
  Mark IV 294
  Mark V 295, 296–97
  PIAT anti-tank gun 359
  Sherman Firefly M4 353
  Whippet, medium Mark A 294, 296
tanks, US
  Adaptive Camouflage 428
  Black Night 428
  M1A1 Abrams MBT 417
  M1A1 "Bazooka" anti-tank gun 359
  M24 Chafee light 353
  M1942 field/anti-tank gun 359
  Sherman Firefly M4 353
  Sherman M4A1 medium 352–53
telescope, Gregorian 203
Terracotta Army 44–45
terrorism 382, 391
  al-Qaeda 428
  Operation Neptune Spear 428
Texas, USS 330–33
  Bofors anti-aircraft guns 330–31
  Oerlikon cannon 331
  submerged mines, dealing with 331
Texel, Battle of 149
Thailand, war elephants 139
Thebans 25
Thirty Years' War
  Breitenfeld, Battle of 126–27
  Magdeburg, Sack of 177
  weapons 117, 129
  White Mountain, Battle of 124–25
Tibet, weapons 166, 169
Til Tuba, Battle of 15
Timur 96, 97
Tokarev
  SVT40 rifle 365
  TT Model 1933 pistol 366
Tonga, war club 253
Tournai, Siege of 170
Trafalgar, Battle of 196, 197, 199
  Victory, HMS *see Victory*, HMS
trench warfare *see under* World War I
Truman Doctrine 384
Tsushima, Battle of 219, 262–65, 268
  "crossing the T" 264–65
  destroyers 264–65
  "line astern" formation 264–65
  wireless telegraphy 264, 269
Tumu, Battle of 104
Turkey
  Crimea medal 258
  Ottoman War medal 324
  tüfek musket, snaphaunce 169
  Turkish Crimean medal 258
  see also Ottoman Empire
Tutankhamen 14–15

U

UK
  Afghanistan *see* Afghanistan
  Air Crew Europe Star 325
  air defence system, early 300, 301
  aircraft *see* aircraft, UK
  armoured vehicles 294–95, 353
  Battle of Britain 301
  bayonets 165, 193, 237
  bicycle, BSA folding bicycle 375
  cannon *see under* cannon
  Congreve rockets 182, 183, 201
  Distinguished Flying Cross 325
  Falklands War 395, 407, 422
  field guns *see under* field guns
  General Service Medal 406
  Gregorian telescope 203
  helicopter, Apache AH Mk1 401
  India General Service medal 258
  Indian Mutiny medal 258
  Iraq Medal 407
  khaki uniforms, adoption of 280
  knuckle-duster, "Middle East" pattern knife 377
  machine-guns *see* machine guns, UK
  Memorial Plaque 324
  Military Cross 324
  Mills Bomb, No. 36 291
  mortars 200, 370–71
  muskets *see under* muskets
  Northern Ireland, General Service Medal 407
  Northern Ireland, bomb-disposal robot 429
  Operation Market Garden 372–73
  Osprey Body Armour 419
  pistols *see* pistols, UK
  Punjab medal 258
  Queen's South Africa medal 259
  rifles *see* rifles, UK
  Rolls-Royce armoured car 294–95
  Second Anglo-Afghan War 259
  ships *see* ships, UK
  South Africa medal 259
  South Atlantic Medal 407
  Special Operations Executive (SOE) 376–77
  spiked club 290–91
  suitcase radio 350, 376
  swords *see* swords, UK
  tanks *see* tanks, UK
  UN Korea Medal 406
  uniforms 40–41, 211, 230–31, 280, 362, 418–19
  Victoria Cross 258
  see also England; Scotland
uniforms
  19th-century armies 230–31
  airborne force, US 374
  American Civil War 234–35
  American Revolutionary War 172–73, 174, 175
  England 57, 116, 163, 210–11
  European 18th century 160–61, 162–63
  France 160, 184–85, 231, 281
  Germany 121, 362
  Italy 121, 231, 280
  Japan 362
  late 19th to 20th century 280–81
  modern warfare 418–19
  Napoleonic Wars 184–85, 186, 187, 188–89
  Prussia 163, 231
  Russia/Soviet Union 162, 281
  UK 40–41, 210–11, 230–31, 280, 362, 418–19
  US 281, 363, 374–75, 419
  Vietnam War 396–97
  World War II 362–63, 374–75
US
  Afghanistan *see* Afghanistan
  Air Force Distinguished Service Medal 406
  aircraft *see* aircraft, US
  armoured vehicles 326, 353, 360–61
  bombs and missiles 319, 395, 423, 445
  crossbow, "Big Joe" 377
  Distinguished Flying Cross 407
  Distinguished Service Cross 407
  Guadalcanal, Battle of 351
  helicopters *see under* helicopters
  Hiroshima and Nagasaki bombing 300, 313, 319, 378–79, 384
  Leyte Gulf, Battle of 348–49
  Little Bighorn, Battle of 241
  M1A1 field gun 370–71
  machine-guns *see* machine-guns, US
  Manhattan Project 379
  Medal of Honor 259
  Midway, Battle of 343
  Normandy landings 340–41
  Operation Cedar Falls *see* Operation Cedar Falls
  Operation Market Garden 372–73
  Operation Neptune Spear 428
  Panoramic Night Vision Goggles (PNVGs) 409
  Pearl Harbor 327, 343
  pistols *see* pistols, US
  Plains Indians' wars 240–41, 246
  Purple Heart medal 325
  Quincy, USS (cruiser) 335
  rifles *see* rifles, US
  SEAL Special Forces 428
  ships *see* ships, US
  swords *see* swords, US
  tanks *see* tanks, US
  terrorism and 9/11 383, 391, 408
  Truman Doctrine 384
  uniforms 281, 363, 374–75, 419
  Vietnam War *see* Vietnam War
  War of Independence 159
  World War I Victory medal 324

V

Valmy, Battle of 183
Vauban, Marquis de 176, 177, 181
Vickers
  "Light Pattern" Model 1908 machine-gun 282
  Mk I machine-gun 368
  Vickers-Maxim "New Light" Model 1906 machine-gun 282
  Vimy 304–05
  Wellington 310
Victory, HMS 212–15
  Blomefield pattern cannon 198–99
  weapons 213, 214–15
Vietnam War 385
  guerrilla warfare 390, 391
  laser-guided bombs 409
  night-vision devices 409
  Operation Cedar Falls *see* Operation Cedar Falls
  US Marine uniform and kit 396–97
  Vietnam Medal 407
  Vietnam Service Medal 407
  weapons 392–93, 396–97, 420
Vikings
  Lindisfarne raid 51
  longship 51, 54–55
  rise of 50
  weapons and armour 50, 52–53
Von Richthofen, Baron (Red Baron) 301, 303

W

War of Austrian Succession 170–71
Warsaw Pact 420–21
Waterloo, Battle of 159, 182
  Hanoverian medal for 258
  Waterloo medal 258
  weapons 179, 194–95
Wellington, Duke of 182, 194–95
White Mountain, Battle of 124–25
William the Conqueror 83
  Hastings, Battle of 58–59
World War I
  air power, growth of 300–01
  airships 300, 343
  Aisne, Battle of the 286
  Arras, Battle of 292–93
  Bayernwald trench 286–87
  bomber aircraft 304–05
  Cambrai, Battle of 279, 296
  capital ships 328–29
  communications equipment 298–99
  convoys 326
  "creeping barrage" 292
  field guns, siege guns, and howitzers 288–89
  gas mask 279
  Jutland, Battle of 326, 328, 334–35
  machine-guns 282–85
  medals 324–25
  Messines, Battle of 279
  Michael offensive 279
  Passchendaele, Battle of 278
  poison gas 276, 278–79, 292
  reconnaissance and fighter aircraft 302–03
  "rolling barrage" shellfire 279
  Scapa Flow 328
  Somme offensive 279, 292
  submarines 338–39
  tanks 279, 294–97
  technology and observation techniques 279
  trench warfare 278–79, 286–87, 290–91
  U-boats 326
  Verdun, Battle of 276, 278
  Ypres, Battle of 279
World War II
  aerial artillery 301
  air attack on warships 326–27
  air power, growth of 300–01
  amphibious operations 351
  artillery 370–71
  atom bomb 276
  Battle of Britain 301
  Blitzkreig ("lightning") tactics 350, 351
  bombers 300, 314–17
  bombs and missiles 318–19
  British Special Operations Executive (SOE) 376–77
  BSA folding bicycle 375
  capital ships 328–29
  carrier and maritime strike aircraft 346–47
  chemical weapons 276
  communication and code-breaking equipment 322–23
  Crete 351
  crossbow, "Big Joe" 377
  Dresden, bombing of 277, 300
  El Alamein, Battle of 276
  fighter and fighter-bomber aircraft 306–09
  flamethrowers 351
  Guadalcanal, Battle of 351
  guided weapon, first use of 409
  Hiroshima and Nagasaki bombing 300, 313, 319, 378–79, 384
  horse-drawn supply trains 351
  kamikaze suicide tactics 342
  Kursk, Battle of 351
  land warfare 350–51
  Leyte Gulf, Battle of 277, 326, 348–49
  magnetic mines 327
  medals 324, 325
  Midway, Battle of 343
  Normandy landings 340–41
  Operation Market Garden 372–73
  Pacific War 327, 343
  Pearl Harbor 327, 343
  submarines 338–39
  suitcase radio 350
  tanks 350, 351, 352–59
  transport, reconnaissance, and liaison aircraft 320–21
  trucks, half-tracks, and light vehicles 360–61
  U-boats 326, 327
  uniforms and equipment 362–63, 374–75

Y

Yorktown, Battle of 158, 161

Z

Zulu Wars 240–41
  clothing and weapons 246, 252–53
  Isandlwana, Battle of 241, 259
  Rorke's Drift 240, 259
  South Africa medal 259

ACKNOWLEDGMENTS

The publisher would like to thank the following consultants and contributors:

ROYAL ARMOURIES CONSULTANTS
Thom Richardson
Keeper of Armour and Oriental Collections

Robert C Woosnam-Savage
Curator of European Edged Weapons

Jonathan Ferguson
Curator of Firearms

Mark Murray-Flutter
Senior Curator of Firearms

Trevor Weston
Manager of Modern Military Firearms

Karen Watts
Senior Curator of Armour and Art

Nicholas Hall
Keeper of Artillery

Philip Magrath
Curator of Artillery

ADDITIONAL CONSULTANTS
Brian Lavery is Curator of Naval History at the **National Maritime Museum**, Greenwich, and author of many books. A highly respected maritime historian, he was consultant on the film *Master and Commander: The Far Side of the World*, and advised on the replica constructions of Captain Cook's *Endeavour*.

Stephen Woolford is Head of Interpretation and Collections at **IWM Duxford**, one of the world's premier aviation museums, where he created the award-winning exhibition AirSpace, the Story of British and Commonwealth Aviation. He was a consultant for DK's *Flight*, and *100 Years of Aviation*. In 2009, he received an MBE for services to heritage.

Information on Measurements
Throughout this book, weights and measurements are provided in both metric and imperial, wherever the information is available, with the following exceptions (according to the convention for each):

- **Calibre (firearms)**
  This is expressed in either millimetres or inches only, depending on the specification given by the manufacturer.
- **Displacement (ships)**
  This is given in long tons only, and corresponds to "full-load/deep" displacement, or that of the ship at full capacity.
- **Displacement (submarines)**
  This is expressed in long tons: the displacement the craft at the surface is given first, with the displacement of the submerged craft in brackets.

CHIEF CONTRIBUTOR
R G Grant is the author of numerous books on aspects of military conflict, including DK's *Battle, Battle at Sea, Soldier* (US: *Warrior*), and *Commanders*. He was a consultant on DK's *History of the World* and a major contributor to the ITV *Visual History of the Twentieth Century*.

CONTRIBUTORS
Philip Parker is the author of the DK *Eyewitness Companion Guide to World History*, and a contributor to DK's bestsellers *Battle, Explorers, History of Britain and Ireland*, and *Mountaineers*. He is currently working on a major new book about the Vikings.

Ian Bottomley was a Further Education lecturer before joining the Royal Armouries as Senior Curator of Oriental Arms and Armour, and is now a Curator Emeritus. He has contributed articles on Indian armour for *The Royal Armouries Yearbook*, and has also written several books on the subject of Japanese arms and armour.

Charles Phillips is the author of more than 30 books, including a history of the Aztec and Maya, and a two-volume narrative of the Crusades and the age of chivalry. He has contributed to bestselling books on military aircraft and the TimeLife *Myth and Mankind* historical series.

Roger Ford is the author of dozens of books on military, maritime, and aviation history and technology, including DK's *Weapon*. His two-volume work on the role of Allied Special Forces in the liberation of France in 1944 is rated as outstanding in that field.

Adrian Gilbert has written extensively on military history and weapons technology – from DK's *Weapon* to specialist titles on snipers and prisoners of war, as well as *The Imperial War Museum Book of the Desert War*. He is currently working on a history of the British Army in 1914.

Malcolm Claridge has headed the Medals and Militaria Department of the auctioneers **Dreweatts** since 2006, specializing in 20th-century warfare, with a particular interest in the World War II in Europe.

The publisher would like to thank the other following individuals and organizations for their generous help in producing this book:

Peter Armstrong, Development Director; Graeme Rimer, Academic Director; Alison Watson, Curatorial Manager; Chris Streek, Image Librarian; Natasha Roberts, Curatorial Assistant Oriental Collections; Victoria Adams, Documentation Assistant; Claire Lambert, Documentation Assistant; Suzanne Kitto, Conservation Manager; and Nyssa Mildwaters, Conservator at the **Royal Armouries** (www.royalarmouries.org); Ellen Nanney and Kealy Wilson at Smithsonian (www.si.edu); Marc Farrance at **Explosion!, Museum of Naval Firepower** (www.explosion.org.uk); Alexandra Geary at the **Royal Navy Submarine Museum** (www.submarine-museum.co.uk); Captain Peter Laidler and Belinda Alley at the **Ministry of Defence**; Martin Langford, David Willey at the **Tank Museum**; (www.tankmuseum.org); Sean Penn at **RAF Hendon** (www.rafmuseum.org.uk/london); the staff at **RAF Cosford** (www.rafmuseum.org.uk/cosford); Clive McPherson and Richard Wooldridge at the **Combined Military Services Museum** (www.cmsm.co.uk); Paul Evans, Mark Smith, Leslie Smith, Steve Hookins, and Wendy Best at the **Royal Artillery Museum** (www.firepower.org.uk); the staff at **Scale Model World** (www.smwshow.com); Wendy Hodkinson, Bryan Sitch, Phyllis Stoddart, and Henry McGhee at **Manchester Museum** (www.museum.manchester.ac.uk); David Hill at **Fleet Air Arm Museum** (www.fleetairarm.com); Laura Iles at the **Royal International Air Tattoo** (www.airtattoo.com); Jacqui Curtis at the **Hop Farm** (www.thehopfarm.co.uk); Rex Cadman at the **War and Peace Show** (www.warandpeaceshow.co.uk); Peter Vallance at **Gatwick Aviation Museum** (www.gatwick-aviation-museum.co.uk); the staff of **Yorkshire Air Museum** (www.yorkshireairmuseum.org); Claire Bowers, Claire Cordier, Romaine Werblow, Martin Copeland, Susie Peachey, Fergus Muir, from DK Images; Karl Stange, for help with fonts; David Roberts and Rob Laidler for database work; Hugh Schermuly and Cathy Meeus for additional design and editorial work; Karen Self and Phil Gamble for design assistance; Kajal Mistry for editorial assistance; and Victoria Khroundina for production editorial assistance.

The publisher would also like to thank the following for their kind permission to reproduce their photographs:

Key:
(a–above; b–below/bottom; c–centre; f–far; l–left; r–right; t–top) (Agency key: Ancient Art & Architecture-AAA; Dorling Kindersley-DK; National Maritime Museum, Greenwich, London-NMM; The Bridgeman Art Library-BAL; The Board of Trustees of the Armouries-RA)

1 DK: Courtesy of the Royal Artillery Historical Trust. **2–3 RA. 10–11 The Trustees of the British Museum. 12 akg-images:** Erich Lessing (br). **The Art Archive:** Egyptian Museum Cairo / Gianni Dagli Orti (bl). **Corbis:** Michael Freeman (bc). **12–13 The Art Archive:** National Museum Bucharest / Collection Dagli Orti (t). **13 The Art Archive:** Musée Archéologique Naples / Gianni Dagli Orti (bl). **Corbis:** Nathan Benn / Ottochrome (br). **Getty Images:** National Geographic / O. Louis Mazzatenta (bc). **14 Corbis:** Mark Karrass (cla). **DK:** The Trustees of the British Museum (bl). **14–15 The Art Archive:** Egyptian Museum Cairo / Gianni Dagli Orti (tc). **15 The Art Archive:** British Museum / Gianni Dagli Orti (tr). **16 The Trustees of the British Museum:** (tr). **DK:** Museum of London (cra); Museum of London (fbl). **16–17 DK:** Science Museum, London (cb). **17 DK:** American Museum of Natural History (c); Museum of London (cla, t). **18 akg-images:** (cl). **AAA Collection:** Ronald Sheridan (tr). **The Trustees of the British Museum:** (bl). **Getty Images:** G. Dagli Orti / De Agostini (cra). **18–19 AAA Collection:** (tc). **19 The Trustees of the British Museum:** (b). **DK:** The Board of Trustees of the Royal Armouries (cra, crb). **20–21 akg-images:** Erich Lessing. **22 DK:** The Trustees of the British Museum (tr, cla, b). **22–23 DK:** The Trustees of the British Museum (c). **23 akg-images:** Bible Land Pictures (ca). **Corbis:** Sandro Vannini (br, clb). **DK:** The Trustees of the British Museum (t). **24 The Art Archive:** Pella Museum Greece / Collection Dagli Orti (bl). **Mary Evans Picture Library:** (cla). **24–25 The Art Archive:** Musée Archéologique Naples / Gianni Dagli Orti (bc). **26 Corbis:** (cla). **DK:** The Trustees of the British Museum (bl, br, tr). **27 BAL:** Shefton Collection, Newcastle University, Great North Museum: Hancock, UK / © Tyne & Wear Archives & Museums (cra). **DK:** Courtesy of 4hoplites (l, br); The Board of Trustees of the Royal Armouries (tr). **28–29 Getty Images:** Leemage. **30–31 DK:** Hellenic Maritime Museum. **The Trireme Trust:** (bc). **32–33 akg-images:** Pietro Baguzzi. **32 DK:** Simon James (cra). **33 The Art Archive:** National Museum Bucharest / Collection Dagli Orti (bc). **BAL:** Museum of Antiquities, Newcastle upon Tyne, UK (tr). **34 DK:** Ermine Street Guard (tr); British Airways Archive Museum Collection (cla); Ermine Street Guard (bl); University Museum of Newcastle (cr). **35 DK:** The Trustees of the British Museum (tl, ca); Ermine Street Guard (br); Ermine Street Guard (tr, bl). **36–37 Alamy Images:** Independent Picture Service. **36 DK:** The Trustees of the British Museum (bl). **37 Corbis:** Nathan Benn / Ottochrome (tc); Araldo de Luca (br). **38–39 DK:** Sharon Spencer / Tyne and Wear Museum. **40 DK:** The Trustees of the British Museum (l, crb). **41 akg-images:** Archiv Gerstenberg / ullstein bild (crb); Museum Kalkriese (tr). **The Trustees of the British Museum:** (fbl). **DK:** The Board of Trustees of the Royal Armouries (cb). **hunarchery.com:** (c). **42 The Art Archive:** Museo di Villa Giulia Rome / Collection Dagli Orti (bl). **Corbis:** Asian Art & Archaeology, Inc. (cla). **42–43 Corbis:** Michael Freeman (b). **43 Corbis:** Asian Art & Archaeology, Inc. **44–45 Getty Images:** National Geographic / O. Louis Mazzatenta. **46–47 DK:** The Board of Trustees of the Royal Armouries. **48 Corbis:** The Gallery Collection. **Getty Images:** Robert Harding World Imagery / Walter Rawlings (bc). **Photo SCALA, Florence:** White Images (br). **48–49 Corbis:** Alfredo Dagli Orti / The Art Archive. **49 akg-images:** Erich Lessing (br). **Corbis:** Burstein Collection; Alfredo Dagli Orti / The Art Archive (bc). **50 Corbis:** The Gallery Collection (cla). **50–51 Getty Images:** BAL. **51 akg-images:** (tr). **52–53 DK:** The Board of Trustees of the Royal Armouries (tc). **52 AAA Collection:** (br). **DK:** Danish National Museum (tr, cra); Vikings of Middle England (cla); Universitets Oldsaksamling, Oslo (clb). **53 DK:** Museum of London (cl, bl); The Board of Trustees of the Royal Armouries (cla, ca). **54 The Viking Ship Museum, Roskilde, Denmark:** (clb, cb, crb, br). **55 The Viking Ship Museum, Roskilde, Denmark:** (l, tr, cra, crb, br). **56 Corbis:** The Gallery Collection (cl). **DK:** Museum of London (cla); The Board of Trustees of the Royal Armouries (clb, bc). **57 RA:** (bl). **The Art Archive:** Ashmolean Museum (fcla). **Ashmolean Museum, Oxford:** (cla). **DK:** Museum of London (t, cra, crb); Vikings of Middle England (clb). **58–59 Getty Images:** Robert Harding World Imagery / Walter Rawlings. **60 Corbis:** Gianni Dagli Orti (cla). **DK:** Wallace Collection, London (bl). **60–61 Corbis:** Alfredo Dagli Orti / The Art Archive (b). **61 Corbis:** Gianni Dagli Orti (tr). **62 RA:** (cr). **63 DK:** The Trustees of the British Museum (tr); The Board of Trustees of the Royal Armouries (tl); Warwick Castle, Warwick (cra); Wallace Collection, London (br). **64–65 DK:** The Board of Trustees of the Royal Armouries. **65 Getty Images:** DeAgostini (br). **66 DK:** The Board of Trustees of the Royal Armouries (tr, cl, clb, crb). **67 DK:** The Board of Trustees of the Royal Armouries (l, tc); Wallace Collection, London (ca, cr, br). **68–69 akg-images:** British Library. **70 akg-images:** Hermann Historica (cla); Erich Lessing (c). **RA:** (br). **BAL:** Germanisches Nationalmuseum, Nuernberg (tr). **70–71 akg-images:** Interfoto (cb). **71 DK:** The Board of Trustees of the Royal Armouries (fcla, ca, c, b); Wallace Collection, London (tr, fclb). **72 Getty Images:** Hulton Archive / Stringer. **72–73 The Art Archive:** British Library. **73 Getty Images:** Hulton Archive (br). **74–75 DK:** Wallace Collection, London (b). **74 RA:** (cb, cl). **DK:** The Board of Trustees of the Royal Armouries (clb). **75 RA:** (ca/two-handed sword). **DK:** The Board of Trustees of the Royal Armouries (c, crb). **76 DK:** The Board of Trustees of the Royal Armouries (cla, cla/rondel dagger, clb). **77 DK:** The Board of Trustees of the Royal Armouries (cra, r, bc); Wallace Collection, London (l/crossbow and arrows); Robin Wigington, Arbour Antiques, Ltd., Stratford-upon-Avon (br). **78–79 DK:** The Board of Trustees of the Royal Armouries. **80–81 The Art Archive:** Bibliothèque Nationale Paris. **82 akg-images:** (cra). **83 akg-images:** Erich Lessing (br). **85 The National Trust Photo Library ©NTPL:** Alasdair Ogilvie (tr, cra). **86–87 Corbis:** Alfredo Dagli Orti / The Art Archive. **87 akg-images:** Erich Lessing (tc). **TopFoto.co.uk:** The Granger Collection (crb). **88 DK:** The Trustees of the British Museum (crb); Order of the Black Prince (cr). **89 DK:** Royal Museum of the Armed Forces and of Military History, Brussels (cl). **90 AAA Collection:** (cla). **90–91 Bibliothèque nationale de France, Paris**. **91 Alamy Images:** The Art Gallery Collection (br). **Corbis:** Werner Forman (tr). **92 akg-images:** Interfoto (l). **Photo SCALA, Florence:** Metropolitan Museum of Art (cla, r, bc). **93 Alamy Images:** World History Archive (cra). **RA:** (br). **94–95 akg-images:** Interfoto (tc). **RA:** (cb). **DK:** The Board of Trustees of the Royal Armouries (c). **94 akg-images:** Interfoto (cla). **RA:** (clb). **DK:** Wallace Collection, London (cra). **Photo SCALA, Florence:** Metropolitan Museum of Art (cla/b). **By kind permission of the trustees of the Wallace Collection, London:** (b). **95 BAL:** Deutsches Historisches Museum, Berlin / DHM (tr). **DK:** The Board of Trustees of the Royal Armouries (r). **Photo SCALA, Florence:** Metropolitan Museum of Art (cla/a). **96 Getty Images:** DEA / C. SAPPA / De Agostini (bl); MPI (cla). **96–97 The Art Archive:** Edinburgh University Library. **97 Corbis:** Burstein Collection (tc). **98 DK:** The Trustees of the British Museum (clb); The Board of Trustees of the Royal Armouries (armour and helmet). **99 DK:** The Trustees of the British Museum (cra); The Board of Trustees of the Royal Armouries (t, crb). **100–101 Photo SCALA, Florence:** White Images. **102 AAA Collection:** (bl). **Photo SCALA, Florence:** Metropolitan Museum of Art / Art Resource (r). **103 Alamy Images:** XenLights (tc). **RA:** (ca). **DK:** The Board of Trustees of the Royal Armouries (cb, b). **104–105 Getty Images:** Vetta / Ilya Terentyev. **106 DK:** CONACULTA-INAH-MEX. Authorized reproduction by the Instituto Nacional de Antropología e Historia (b). **106–107 BAL:** Bibliotheque Nationale, Paris, France (t). **107 Getty Images:** DEA / G. DAGLI ORTI / De Agostini (bc); DEA PICTURE LIBRARY / De Agostini (br). **108–109 DK:** CONACULTA-INAH-MEX. Authorized reproduction by the Instituto Nacional de Antropología e Historia (c). **108 AAA Collection:** (bc). **Corbis:** Werner Forman (cra, l). **109 DK:** CONACULTA-INAH-MEX. Authorized reproduction by the Instituto Nacional de Antropología e Historia (tr, ca/flint knife, ca/atlatl); Trustees of the National Museums Of Scotland (cl); Michel Zabe (br). **110–111 Getty Images:** BAL. **114 BAL:** Topkapi Palace Museum, Istanbul, Turkey / BAL (bc). **DNP Art Image Archives:** Tokugawa Art Museum (br). **Getty Images:** Leemage (bl). **114–115 akg-images:** Rabatti – Domingie. **115 akg-images:** Nimatallah (bc); (br). **The Art Archive:** National Maritime Museum London / Harper Collins Publishers (bl). **116–117 The Art Archive:** Basilique Saint Denis Paris / Gianni Dagli Orti. **116 DK:** Courtesy of the English CIvil War Society (tr/a, tr/b, tr/c). **117 akg-images:** Rabatti – Domingie (t). **Wikipedia:** (br). **120 RA:** (cl, cla). **DK:** Courtesy of the Wallace Collection, London (c). **121 RA:** (cra, cr). **DK:** The Board of Trustees of the Royal Armouries (t); Wallace Collection, London (cl). **122–123 DK:** The Board of Trustees of the Royal Armouries. **123 Corbis:** Bettmann (tr). **124–125 akg-images:** Nimatallah. **126 akg-images:** (cla). **DK:** The Board of Trustees of the Royal Armouries (bl). **126–127 akg-images:** (tc). **127 The Art Archive:** Cromwell Museum (br). **129 DK:** Warwick Castle, Warwick (crb). **130 Alamy Images:** Ilian Photo (tr). **Getty Images:** Danita Delimont (bc); Leemage (br). **131 akg-images**. **132 RA:** (b). **DK:** The Board of Trustees of the Royal Armouries (tc, cl). **132–133 DK:** The Board of Trustees of the Royal Armouries (c). **133 RA:** (tr). **DK:** The Board of Trustees of the Royal Armouries (tl, crb, cb, b). **134–135 BAL:** Topkapi Palace Museum, Istanbul, Turkey / BAL. **136 RA:** (bl). **DK:** The Board of Trustees of the Royal Armouries (tc, r, cla/scabbard). **137 DK:** The Board of Trustees of the Royal Armouries (cla, fcla, bl, bc, br). **138 AAA Collection:** Europhoto (bl). **138–139 DNP Art Image Archives:** Tokugawa Art Museum. **139 BAL:** British Library Board. All Rights Reserved (tr). **Corbis:** Bettmann (br). **140 DK:** The Board of Trustees of the Royal Armouries (cra, ca/sword and scabbard). **141 RA:** (b, cr). **DK:** The Board of Trustees of the Royal Armouries (cra/tanto and scabbard). **142 RA:** (cb, b). **DK:** The Board of Trustees of the Royal Armouries (ca). **143 RA:** (crb). **DK:** The Board of Trustees of the Royal Armouries (cb, b). **144–145 DK:** The Board of Trustees of the Royal Armouries (c). **144 RA:** (bc). **DK:** The Board of Trustees of the Royal Armouries (bl, cr, br, tr). **145 DK:** The Board of Trustees of the Royal Armouries (tl, cl, cr, br). **146–147 Werner Forman Archive:** Kuroda Collection, Japan. **148 Corbis:** (cla). **148–149 The Art Archive:** National Maritime Museum London / Harper Collins Publishers (tc). **149 NMM:** (tr). **150–153 DK:** Barcelona Maritime Museum. **151 SuperStock:** Stock Connection. **154–155 NMM**. **156–157 DK:** The Board of Trustees of the Armouries. **158 BAL:** Chateau de Versailles, France / Flammarion Giraudon (bc); Delaware Art Museum, Wilmington, USA / Howard Pyle Collection (br). **Photo SCALA, Florence:** BPK, Bildagentur fuer Kunst, Kultur und Geschichte, Berlin (bl). **158–159 The Art Archive:** Musée du Château de Versailles / Gianni Dagli Orti (t). **159 akg-images:** (bc). **Corbis:** Derek Bayes – Art / Lebrecht Music & Arts (bl). **National Gallery Of Victoria, Melbourne:** Elizabeth Thompson, English 1846–1933 The 28th Regiment at Quatre Bas 1875 detail.; Oil on canvas 97.2 x 216.2 cm National Gallery of Victoria, Melbourne. Purchased 1884 (br). **160 BAL:** Private Collection (b). **DK:** Courtesy of David Edge (clb). **Getty Images:** Hulton Archive (cla). **161 BAL:** Delaware Art Museum, Wilmington, USA / Howard Pyle Collection. **162 Alamy Images:** Interfoto (tc). **Getty Images:** (r). **The State Hermitage Museum, St Petersburg:** Vladimir Terebenin, Leonard Kheifets, Yuri Molodkovets (cl). **163 akg-images:** Interfoto (tl); (br). **DK:** Courtesy of Warwick Castle, Warwick (tr). **National Army Museum:** (tc). **164–165 RA:** (c). **DK:** The Board of Trustees of the Armouries (b). **164 DK:** Wallace Collection, London (ca). **165 RA:** (t, cra, ca). **DK:** The Board of Trustees of the Armouries (cb). **166–167 DK:** The Board of Trustees of the Armouries (c, t). **167 DK:** Courtesy of the Board of Trustees of the Royal Armouries. (cra). **168–169 DK:** Courtesy of the Board of Trustees of the Royal Armouries (t, ca, cb). **168 DK:** Courtesy of the Board of Trustees of the Royal Armouries (ca, cb). **169 DK:** Courtesy of the Board of Trustees of the Royal Armouries (t, cb, b). **170–171 BAL:** Chateau de Versailles, France. **172 DK:** Courtesy of Queen's Rangers (cl, clb, bc, cr). **173 DK:** Courtesy of Queen's Rangers (cla, cra, cl, br). **174 DK:** Courtesy of Queen's Rangers (cl, bl, cb, cr, crb). **175 RA:** (ca). **DK:** Courtesy of the Board of Trustees of the Royal Armouries (t). **176 Alamy Images:** The Art Gallery Collection (cl). **www.historicalimagebank.com:** (bl). **176–177 The Art Archive:** Musée du Château de Versailles / Gianni Dagli Orti (b). **177 Photo SCALA, Florence:** BPK, Bildagentur fuer Kunst, Kultur und Geschichte, Berlin (ca). **178 DK:** Courtesy of Robin Wigington, Arbour Antiques, Ltd., Stratford-upon-Avon (cla). **179 DK:** Courtesy of the Peter Chadwick (c) Museum of Artillery, The Rotunda, Woolwich, London (cla). **180–181 BAL:** Chateau de Versailles, France / Flammarion Giraudon. **182 Getty Images:** SuperStock (cla). **182–183 akg-images:** (bc). **183 Corbis:** The Gallery Collection (br). **Getty Images:** SSPL (tr). **184–185 DK:** Courtesy of David Edge (c). **184 DK:** The Board of Trustees of the Armouries (cb); Courtesy of the Musee de l'Emperi, Salon-de-Provence (l); Courtesy of David Edge (cra). **185 DK:** Courtesy of the Musee de l'Emperi, Salon-de-Provence (tc, tr, bc, br). **186 DK:** Courtesy of 1er Chasseurs a Cheval de la Lighne, 2e Compagnie (cla, ca, cra, br); Courtesy of John Norris (clb, bc). **187 DK:** Courtesy of David Edge (bl, cra, cl); Courtesy of the Board of Trustees of the Royal Armouries (br). **188 DK:** Courtesy of the 68th Durham Light Infantry (clb, cr, tr, crb, cb); Courtesy of the 95th Rifles and Re-enactment Living History Unit (c, bl). **189 DK:** Courtesy of the 68th Durham Light Infantry (tl, cl); David Edge (crb). **190 DK:** The Board of Trustees of the Armouries (tl, ca, cb, b). **191 DK:** The Board of Trustees of the Armouries (tr, ca, cb); Courtesy of David Edge (tl). **192–193 DK:** The Board of Trustees of the Royal Armouries. **192 DK:** Courtesy of the 95th Rifles and Re-enactment Living History Unit (tr/b); The Board of Trustees of the Royal Armouries (tr, br). **193 DK:** The Board of Trustees of the Royal Armouries (tr, clb, bc). **194–195 National Gallery Of Victoria, Melbourne:** Elizabeth Thompson, English 1846–1933 The 28th Regiment at Quatre Bas 1875 detail.; Oil on canvas 97.2 x 216.2 cm National Gallery of Victoria, Melbourne. Purchased 1884. **196 Getty Images:** BAL / Sir William Beechey (cl). **196–197 NMM:** (tc). **197 BAL:** Private Collection (tr). **200–201 DK:** The Board of Trustees of the Armouries (tc). **200 Statens Maritima Museer:** (cla). **201 DK:** (tl). **Getty Images:** SSPL (cr). **202 Corbis:** Austrian Archives (tr). **DK:** National Maritime Museum, Greenwich, London (bc). **202–203 DK:** National Maritime Museum, Greenwich, London (bc). **203 DK:** Dave King (a, c/br, d/br); National Maritime Museum, Greenwich, London (tl, cla, c). **NMM:** (clb). **204–205 NMM:** (tc, c, cb). **204 RA:** (cb). **NMM:** (cla). **205 RA:** (cb). **NMM:** (ca, bc). **206–207 Corbis:** Derek Bayes – Art / Lebrecht Music & Arts. **208 DK:** Board of Trustees of the Royal Armouries (cl); Courtesy of the Board of Trustees of the Royal Armouries (bc, c, tr). **208–209 DK:** Courtesy of the Board of Trustees of the Royal Armouries (c, cb). **209 DK:** Courtesy of the Royal Armouries (cl, clb, tr, c, bc, br). **210 DK:** The Board of Trustees of the Armouries (bl); Judith Miller, Judith Miller / Gorringes (clb). **NMM:** (tc, cl). **210–211 NMM:** (c). **211 NMM:** (cl, bl, ca, r). **212 DK:** HMS Victory, Portsmouth Historic Dockyard (bl, crb); Royal Navy Museum, Crown Copyright / Queen's Printer (cl, bc, br). **213 DK:** HMS Victory, Portsmouth Historic Dockyard (br); Royal Navy Museum, Crown Copyright / Queen's Printer (tl, tr, tc, c, bl). **214 DK:** HMS Victory, Portsmouth Historic Dockyard (tr, bc); Royal Navy Museum, Crown Copyright / Queen's Printer (bl). **214–215 DK:** HMS Victory, Portsmouth Historic Dockyard (tc); Royal Navy Museum, Crown Copyright / Queen's Printer (c, bc). **215 DK:** HMS Victory, Portsmouth Historic Dockyard (tc, cl); Royal Navy Museum, Crown Copyright / Queen's Printer (tr, cr, r, bc, br). **218–219 Getty Images:** Alexander Gardner / Buyenlarge. **218 The Art Archive:** Musée Carnavalet Paris / Gianni Dagli Orti (bc). **Corbis:** (br). **Library Of Congress, Washington, D.C.:** (bl). **219 The Art Archive:** (bc). **BAL:** Walker Art Gallery, National Museums Liverpool (bl). **TopFoto.co.uk:** The Granger Collection (br). **220–221 Library Of Congress, Washington, D.C.:** (b). **220 DK:** Courtesy of the Board of Trustees of the Royal Armouries (cl). **Getty Images:** Time Life Pictures / Mansell / Time Life Pictures (cla). **221 The Art Archive:** Musée Carnavalet Paris / Gianni Dagli Orti (tr). **222–223 DK:** Courtesy of the Board of Trustees of the Royal Armouries (ca, c, b). **222 DK:** Courtesy of the Board of Trustees of the Royal Armouries (c). **223 DK:** Courtesy of the Board of Trustees of the Royal Armouries (t, c, cb, b). **224 DK:** Courtesy of the Board of Trustees of the Royal Armouries (tr, c, clb, crb, bl). **224–225 DK:** Courtesy of the Board of Trustees of the Royal Armouries (ca, c). **225 DK:** Courtesy of the Board of Trustees of the Royal Armouries (tl, tr, cra, cr, clb, bl); Courtesy of the Gettysburg National Military Park, PA (cb, br). **226 DK:** Courtesy of the Gettysburg National Military Park, PA (tr); Courtesy of the Board of Trustees of the Royal Armouries (ca, bl). **228–229 DK:** Courtesy of the Board of Trustees of the Royal Armouries (t, cb). **228 DK:** Courtesy of the Board of Trustees of the Royal Armouries (ca). **229 DK:** Courtesy of the Board of Trustees of the Royal Armouries (cla, ca, cb, clb, b). **230–231 Getty Images:** BAL / Courtesy of the Council, National Army Museum, London, UK. **231 DK:** Christopher Seidler / Judith Miller (tc). **Getty Images:** DEA / G. Cigolini (tl, br, bc). **232–233 Getty Images:** Alexander Gardner / Buyenlarge. **234–235 DK:** Courtesy of the Civil War Library and Museum, Philadelphia (tc); Courtesy of the Gettysburg National Military Park, PA (c). **235 Corbis:** Tria Giovan (cl). **DK:** Courtesy of the Southern Skirmish Association (tc, cra, cb, bl, br); Courtesy of the Civil War Library and Museum, Philadelphia (crb). **236–237 DK:** Courtesy of the Confederate Memorial Hall, New Orleans (c); Courtesy of the Board of Trustees of the Royal Armouries (cb). **236 DK:** Courtesy of the Board of Trustees of the Royal Armouries (cb, crb, b). **237 DK:** Courtesy of the Gettysburg National Military Park, PA (t, ca); Courtesy of the Board of Trustees of the Royal Armouries (tl, cb, b). **240–241 Corbis:** Stapleton Collection (b). **240 DK:** By kind permission of The Trustees of the Imperial War Museum, London (bl). **241 Getty Images:** De Agostini Picture Library (tc); Universal History Archive (crb). **242–243 DK:** Courtesy of the Royal Artillery Historical Trust (t, ca). **242 DK:** Courtesy of the Board of Trustees of the Royal Armouries (cb). **243 DK:** Courtesy of the Board of Trustees of the Royal Armouries (ca, cb). **244 DK:** Royal Artillery Museum, Courtesy of Firepower, The Royal Artillery Museum, Royal Artillery Historical Trust (cl). **245 RA:** (clb). **DK:** Courtesy of the Royal Artillery Historical Trust (tl); By kind permission of The Trustees of the Imperial War Museum, London (tr). **246 The Art Archive:** (bc). **DK:** Courtesy of the Royal Artillery Historical Trust (cla). **246–247 DK:** Courtesy of the Royal Artillery Historical Trust (c). **250–251 DK:** The Board of Trustees of the Royal Armouries (ca). **250 BAL:** Private Collection / Photo Heini Schneebeli (cb). **DK:** Courtesy of the Powell-Cotton Museum, Kent (cr, bl). **251 DK:** Courtesy of the University Museum of Archaeology and Anthropology, Cambridge (clb); The Board of Trustees of the Royal Armouries (t, cla, bc, br). **252–253 BAL:** Walker Art Gallery, National Museums Liverpool. **254–255 DK:** The Board of Trustees of the Royal Armouries (t). **254 DK:** The Board of Trustees of the Royal Armouries (clb, cr, bl, br). **255 DK:** The Board of Trustees of the Royal Armouries (cra, cr, br, bl). **256–257 The Art Archive**. **258 DK:** Courtesy of the Royal Green Jackets Museum, Winchester (tc, c). **Dreweatts, The Fine Art Auction Group:** (ftr, fcl, bl, bc, cr). **259 DK:** Courtesy of Spink and Son Ltd, London (tc); Duxford / By kind permission of The Trustees of the Imperial War Museum, London (clb); Courtesy of the Royal Green Jackets Museum, Winchester (br, fcrb). **Dreweatts, The Fine Art Auction Group:** (fcl). **neateauctions.co.uk / neatemedals.co.uk:** (cb). **260–261 Corbis**. **261 Corbis:** Bettmann (br); (cra). **The Royal Navy Submarine Museum, Gosport:** (cr). **262 NMM:** (tr, cla, crb, clb). **262–263 NMM:** (b). **263 NMM:** (tr, cla, crb). **264–265 TopFoto.co.uk:** The Granger Collection. **266–269 DK:** Mikasa Preservation Society. **270 NMM:** (tr, cla, cr). **270–271 NMM:** (b). **271 NMM:** (t, c, b). **272 NMM:** (tr, cla, cl, br). **272–273 NMM:** (c, cb, b). **273 NMM:** (tl, tr). **276 Getty Images:** Galerie Bilderwelt (br); Hulton Archive (bl). **TopFoto.co.uk:** (bc). **276–277 Getty Images:** MPI (t). **277 Corbis:** (bl); Hulton-Deutsch Collection (bc). **The US National Archives and Records Administration:** (br). **278 Getty Images:** Hulton Archive (cla). **278–279 The Art Archive:** Australian War Memorial (b). **279 Corbis:**

Bettmann (tl). **Getty Images:** SSPL. **280 DK:** Courtesy of the Royal Artillery Historical Trust (tr); John Pearce (cla, c, bl); The Board of Trustees of the Armouries (clb); Gary Ombler / "Collection of Jean-Pierre Verney" (br). **281 DK:** Gary Ombler / "Collection of Jean-Pierre Verney" (l, crb). **282–283 Alamy Images:** Interfoto. **DK:** Gary Ombler / "Collection of Jean-Pierre Verney" (bc). **282 DK:** The Board of Trustees of the Armouries (bl). **283 RA:** (bc). **DK:** The Board of Trustees of the Armouries (tr, crb). **284 RA:** (cla). **284–285 RA:** (cb). **DK:** The Board of Trustees of the Royal Armouries (tc). **285 DK:** The Board of Trustees of the Royal Armouries (crb). **286–287 Peter Gombeir:** Bayernwald Trench. **288 DK:** Courtesy of the Royal Artillery Historical Trust (cl); By kind permission of The Trustees of the Imperial War Museum, London (br). **288–289 DK:** Courtesy of the Royal Artillery Historical Trust (c). **289 DK:** Courtesy of the Royal Artillery Historical Trust (tr). **290 RA:** (cr). **DK:** Board of Trustees of the Royal Armouries (cla, bl); Board of Trustees of the Royal Armourie (cl). **290–291 DK:** Board of Trustees of the Royal Armouries (t); Gary Ombler / "Collection of Jean-Pierre Verney" (c, cb). **291 DK:** Board of Trustees of the Royal Armouries (cra); Courtesy of the RAF Museum, Hendon (b); Courtesy of the Imperial War Museum, London (cr, crb). **292–293 TopFoto.co.uk**. **294 RA**. **DK:** By kind permission of The Trustees of the Imperial War Museum, London (cla). **295 Alamy Images:** Maurice Savage (crb). **298–299 Imperial War Museum**. **298 DK:** Courtesy of the South Staffordshire Regiment (cl); National Maritime Museum, Greenwich, London (tr). **Imperial War Museum:** (cr, bl). **299 Australian War Memorial:** (cla, br). **DK:** By kind permission of The Trustees of the Imperial War Museum, London (tl, crb); Gary Ombler / "Collection of Jean-Pierre Verney" (tr). **300 Corbis:** Hulton-Deutsch Collection (bc). **300–301 Getty Images:** (b). **301 DK:** Courtesy of Tim Parker (cra, tr). **Getty Images:** Hulton Archive (br). **302 The Flight Collection:** (clb). **303 Alamy Images:** Susan & Allan Parker (crb). **304 Alamy Images:** Airpix (cb). **Canada Aviation and Space Museum:** (bl). **Royal Air Force Museum, Hendon:** (cla). **TopFoto.co.uk:** RIA Novosti / Igor Mikhalev (tr). **304–305 National Air and Space Museum, Smithsonian Institution:** (ca). **305 National Air and Space Museum, Smithsonian Institution:** (cr). **306–307 The Aviation Picture Library:** Austin Brown (bc). **307 Alamy Images:** BG Motorsports (cra). **aviation-images.com:** K Tokunaga (br). **308–309 DK:** Musée de l'Air et de l'Espace / Le Bourget. **309 National Air and Space Museum, Smithsonian Institution:** (tr). **310–311 DK:** Courtesy of Lincolnshire Aviation Heritage Centre. **311 DK:** Texas Parks and Wildlife Department (c); York Museums Trust (Yorkshire Museum). Reproduced by courtesy of the Yorkshire Museum (ca). **313 Richard Vandervord:** (tr). **314–315 Global Aviation Resource/Karl Drage:** Glenn Beasley (bc). **314 DK:** By kind permission of The Trustees of the Imperial War Museum, London (cl); By kind permission of The Trustees of the Imperial War Museum, London (bc); By kind permission of The Trustees of the Imperial War Museum, London (c); By kind permission of The Trustees of the Imperial War Museum, London (bl). **315 Alamy Images:** Nic Hamilton (tl, tc). **DK:** (ca, br); By kind permission of The Trustees of the Imperial War Museum, London (cra); By kind permission of The Trustees of the Imperial War Museum, London (cr). **316 DK:** By kind permission of The Trustees of the Imperial War Museum, London (bl); By kind permission of The Trustees of the Imperial War Museum, London (br). **316–317 DK**. **319 DK:** Courtesy of the Bradbury Science Museum, Los Alamos (bc, cl). **National Air and Space Museum, Smithsonian Institution:** (tl). **320 Alamy Images:** Graham Mulrooney (cla). **322 DK:** By kind permission of The Trustees of the Imperial War Museum, London (bl). **Military Wireless Museum:** Ben Nock (ca). **322–323 DK:** By kind permission of The Trustees of the Imperial War Museum, London (c). **323 DK:** H. Keith Melton, spymuseum.org (c); By kind permission of The Trustees of the Imperial War Museum, London (tl, clb); Royal Signals Museum, Blandford Camp, Dorset (br). **324 DK:** By kind permission of The Trustees of the Imperial War Museum, London (tc); By kind permission of The Trustees of the Imperial War Museum, London (cr). **Dreweatts, The Fine Art Auction Group:** (fcla, crb, fcr). **Wikipedia:** Ian Watts / Pagan (cla). **325 DK:** Courtesy of Andrew L Chernack (fcr). **Dreweatts, The Fine Art Auction Group:** (tl, tc, c, br). **Imperial War Museum**. **326–327 Getty Images:** MPI (bc). **326 Bovington Tank Museum:** (bl). **327 Corbis:** (br). **TopFoto.co.uk:** (tc). **328 NMM:** (bl). **SD Model Makers:** (cl). **328–329 SD Model Makers:** (cb). **329 SD Model Makers:** (t, cb, b). **330 DK:** Texas Parks and Wildlife Department (cl, c, bc, cb). **330–331 DK:** Texas Parks and Wildlife Department (b). **331 DK:** Texas Parks and Wildlife Department (tl, tr, cl, cr, crb, br). **332 DK:** Texas Parks and Wildlife Department (tc, tr, ca, c, cl, bc, bl). **332–333 DK:** Texas Parks and Wildlife Department (bc). **333 DK:** Texas Parks and Wildlife Department (tl, tc, ca, c, cr, bc, br). **334 NMM:** (t, cl). **SD Model Makers:** (bl). **334–335 NMM:** (t). **SD Model Makers:** (cb). **335 SD Model Makers:** (cb). **336 NMM:** (tr, ca). **337 SD Model Makers:** (t, c). **338 NMM:** (clb, bc). **SD Model Makers:** (tr, ca). **339 SD Model Makers:** (cra). **340–341 Getty Images:** Time Life Pictures / US Army Air Force. **342 Corbis:** Hulton-Deutsch Collection (cla). **342–343 The US National Archives and Records Administration:** (tc). **343 Cody Images:** (tr). **344–345 SD Model Makers:** (t). **344 SD Model Makers:** (c, b). **345 SD Model Makers:** (t, c, bl). **346 Alamy Images:** Jeremy Cozannet (crb); Transtock Inc. (cla). **aviation-images.com:** K Tokunaga (bl). **Corbis:** Skyscan (tr). **347 Alamy Images:** CS-Stock (crb); Tony Hobbs (tl). **DK:** Old Flying Machine Company (br). **348–349 Corbis**. **350–351 Getty Images:** Galerie Bilderwelt (b). **350 Corbis:** Bettmann (bl). **DK:** Royal Signals Museum, Blandford Camp, Dorset (tl). **351 Mary Evans Picture Library:** Robert Hunt Library (tc). **358 DK:** Courtesy of the Royal Artillery Historical Trust (tr); The Board of Trustees of the Armouries (cl); Courtesy of the Ministry of Defence Pattern Room, Nottingham (clb). **358–359 DK:** Courtesy of the Royal Artillery Historical Trust (c). **359 DK:** Courtesy of the Royal Artillery Historical Trust (cr); The Board of Trustees of the Armouries (tl, ca). **360–361 Alamy Images:** John Cairns (ca). **DK:** Courtesy of Neill Bruce and Peter Roberts (b). **361 DK:** By kind permission of The Trustees of the Imperial War Museum, London (br). **362 RA:** (crb). **DK:** Courtesy of the Michael Butler Collection (tr, cra); By kind permission of The Trustees of the Imperial War Museum, London (l); By kind permission of The Trustees of the Imperial War Museum, London (br). **363 RA:** (tr). **DK:** Courtesy of Adrian Stevenson – Second Guards Rifles Division (br); Courtesy of Tim Parker (tl, bl). **364 DK:** By kind permission of The Trustees of the Imperial War Museum, London (cra); The Board of Trustees of the Royal Armouries (tr, cla, cr, clb). **364–365 DK:** The Board of Trustees of the Royal Armouries (bc). **365 DK:** The Board of Trustees of the Royal Armouries (t, ca, c, br). **366 DK:** The Board of Trustees of the Royal Armouries (tr, ca/Thompson M1921 and round drum magazine, b); Second Guards Rifles Division (cl). **367 DK:** The Board of Trustees of the Royal Armouries (tr, ca, cra, fclb). **369 DK:** Courtesy of the Royal Artillery Historical Trust (cra); The Board of Trustees of the Royal Armouries (tl, c, br). **370 DK:** Courtesy of the Royal Artillery Historical Trust (crb). **371 DK:** Courtesy of the Royal Artillery Historical Trust (cr, b); By kind permission of The Trustees of the Imperial War Museum, London (tr). **372–373 Getty Images:** Popperfoto. **374 DK:** Courtesy of Tim Parker (tc, cr). **375 RA:** (bl). **DK:** Courtesy of Tim Parker (tl); The Board of Trustees of the Royal Armouries (fcra). **376 DK:** Imperial War Museum, London (r); Royal Signals Museum, Blandford Camp, Dorset (bc). **377 RA:** (tl, tl/sheath, b). **DK:** Ministry of Defence Pattern Room, Nottingham (crb); RAF Museum, Hendon (tr); The Board of Trustees of the Royal Armouries (cla). **378–379 Corbis:** Hulton-Deutsch Collection. **382 akg-images:** (bc). **Corbis:** Sergei Chirikov / epa (bl). **Global Aviation Resource/Karl Drage:** (br). **382–383 Corbis:** Mohammed Khodor / Reuters (t). **383 Corbis:** Sean Adair / Reuters (bl); Patrick Robert (bc); Bryan Denton (br). **384–385 Corbis:** Bettmann (b). **384 Corbis:** Sergei Chirikov / epa (tl). **385 Cody Images:** (tr). **386–387 Alamy Images:** Matthew Harrison (tc). **The Aviation Picture Library:** Austin Brown (c). **DK:** By kind permission of The Trustees of the Imperial War Museum, London (bc). **386 Alamy Images:** Airpix (cla); Allstar Picture Library (bl). **387 aviation-images.com:** P Foster (cb). **Corbis:** Bettmann (c). **Global Aviation Resource/Karl Drage:** Lindsay Peacock (t). **388–389 The US National Archives and Records Administration:** (b). **390–391 Corbis:** Bettmann (t). **390 Corbis:** Mohammed Khodor / Reuters (bl); Swim Ink (br). **391 DK:** The Board of Trustees of the Royal Armouries (br). **392–393 DK:** The Board of Trustees of the Royal Armouries (tc, c). **392 DK:** The Board of Trustees of the Royal Armouries (cl, clb, br). **393 DK:** The Board of Trustees of the Royal Armouries (ca, b). **394–395 DK:** The Board of Trustees of the Armouries (tc, bc, c). **394 Alamy Images:** Stocktrek Images, Inc. (cb). **DK:** The Board of Trustees of the Armouries (bl). **395 DK:** The Board of Trustees of the Armouries (t, cr). **396 DK:** Vietnam Rolling Thunder (tr). **397 DK:** The Board of Trustees of the Royal Armouries (ca, clb, b). **398–399 akg-images**. **400 Alamy Images:** Richard Wareham Fotografie (br). **Andrew Dent:** (tc). **401 Alamy Images:** Andrew Chittock (cra); Antony Nettle (crb). **DK:** Army Base Dishforth, North Yorkshire, 9th Regiment Army Corps (bl). **402–403 DK:** Crown Copyright / MOD. **Global Aviation Resource/Karl Drage:** (t). **404 DK:** Ministry of Defence Pattern Room, Nottingham (cra); The Board of Trustees of the Royal Armouries (tr, clb, bl). **405 DK:** The Board of Trustees of the Royal Armouries (bl, fcra, crb). **406 Dreweatts, The Fine Art Auction Group:** (cl, c). **medal-medaille.com:** (tc, fcla). **Hugh Schermuly:** Schermuly Design Co. (cr). **www.historicalimagebank.com:** (fbl). **407 Dreweatts, The Fine Art Auction Group:** (ftr, cr). **Ministry of Defence Picture Library:** MOD 2012 / Steve Dock LBIPP / Crown Copyright (cb). **National Air and Space Museum, Smithsonian Institution:** (ftl, fbl, br). **Spink and Son Ltd, London:** (tl). **408 Corbis:** Sean Adair / Reuters (cra). **408–409 US Army**. **409 Corbis:** Patrick Robert (t). **410 Alamy Images:** David Osborn (tr). **DK:** RAF Hendon (cla). **412–413 Global Aviation Resource/Karl Drage:** Kevin Jackson. **412 AirTeamImages.com:** (cl). **Dr Séan Wilson / www.primeimages.co.uk:** (clb). **413 aviation-images.com:** Mark Wagner (ca). **Burkhard Domke:** (c, cl). **DK:** Gary Ombler / Courtesy of Lockheed Martin (br). **Global Aviation Resource/Karl Drage:** Karl Drage (tc, cr). **Courtesy of Lockheed Martin Corporation:** (tl). **Dr Séan Wilson / www.primeimages.co.uk:** (bl). **414 Alamy Images:** Airpix (bl). **Global Aviation Resource/Karl Drage:** Lindsay Peacock (clb). **414–415 Alamy Images:** Kevin Maskell. **415 aviation-images.com:** P Foster (tr). **416–417 Dreamstime.com:** Vladj55 (b). **417 Alamy Images:** Stocktrek Images, Inc. (ca). **418 Alamy Images:** Élan Images (l); Military Images (crb). **DK:** The Board of Trustees of the Armouries (tr, br). **418–419 DK:** The Board of Trustees of the Armouries (tc, bc). **419 Dreamstime.com:** Mediaimage (tr, cl, bl). **420–421 DK:** The Board of Trustees of the Royal Armouries (tc, c). **421 DK:** Ministry of Defence Pattern Room, Nottingham (cr); The Board of Trustees of the Royal Armouries (tr, cla). **422 NMM:** (b). **SD Model Makers:** (tr, clb). **423 NMM:** (tl). **SD Model Makers:** (tr, clb, br). **425 NAVY.mil:** Photographer's Mate 3rd Class Summer M. Anderson (b). **428 Corbis:** US Army / Handout (bl). **Getty Images:** AFP (cl). **428–429 Corbis:** U.S. Navy – digital version copy (b). **429 Getty Images:** (tr). **430 NAVY.mil:** (br, cr). **430–433 DK:** USS *Donald Cook*. **434 SD Model Makers:** (tr, clb, bc). **436–437 Corbis:** Bryan Denton. **213.** **213 DK:** Royal Navy Museum, Crown Copyright / Queen's Printer (bc). **2236 DK:** Courtesy of the Board of Trustees of the Royal Armouries (tr).

Jacket images: *Front and Back: Front:* **akg-images:** 43; **Alamy Images:** David J. Green 37, Susan & Allan Parker 33, Photos 12 39, Stocktrek Images, Inc. 38; **Ancient Art & Architecture Collection:** 11; **The Board of Trustees of the Armouries:** 14, 15, 16, 19, 23, 27; **The Bridgeman Art Library:** Private Collection / Photo © Agnew's, London, UK 45; **Corbis:** 47, Bettmann 48, Araldo de Luca 41, Skyscan 35; **DK:** The Board of Trustees of the Armouries 21, Courtesy of 4hoplites 18, Courtesy of Andrew L Chernack 6, Courtesy of Spink and Son Ltd, London 2, 5, By kind permission of The Trustees of the Imperial War Museum, London 3, Courtesy of the Royal Artillery Historical Trust 29, Museum of London 17, The Board of Trustees of the Royal Armouries 12, 20, Second Guards Rifles Division 24, Christopher Seidler 13, Wallace Collection, London 10; **Getty Images:** The Bridgeman Art Library / Sir William Beechey 46, Imagno 44, MPI 42; **National Air and Space Museum, Smithsonian Institution:** 8; **RMN:** Paris – Musée de l'Armée 26; **Hugh Schermuly:** Schermuly Design Co. 7; *Back*: **akg-images:** 43; **Alamy Images:** David J. Green 37, Susan & Allan Parker 33, Photos 12 39, Stocktrek Images, Inc. 38; **Ancient Art & Architecture Collection:** 11; **The Board of Trustees of the Armouries:** 14, 15, 16, 19, 23, 27; **The Bridgeman Art Library:** Private Collection / Photo © Agnew's, London, UK 45; **Corbis:** 47, Bettmann 48, Araldo de Luca 41, Skyscan 34; **DK:** 1, The Board of Trustees of the Armouries 21, Courtesy of 4hoplites 18, Courtesy of Andrew L Chernack 6, Courtesy of Spink and Son Ltd, London 2, 5, By kind permission of The Trustees of the Imperial War Museum, London 3, Courtesy of the Royal Artillery Historical Trust 29, Museum of London 17, The Board of Trustees of the Royal Armouries 12, 20, Second Guards Rifles Division 24, Christopher Seidler 13, Wallace Collection, London 10; **Getty Images:** The Bridgeman Art Library / Sir William Beechey 46, Imagno 44, MPI 42; **National Air and Space Museum, Smithsonian Institution:** 8; **RMN:** Paris—Musée de l'Armée 26; **Hugh Schermuly:** Schermuly Design Co. 7; *Spine:* **The Board of Trustees of the Armouries:** 2; **Corbis:** 4; **DK:** The Board of Trustees of the Armouries 3, Courtesy of Spink and Son Ltd, London 1, Courtesy of the Royal Artillery Historical Trust; **Getty Images:** The Bridgeman Art Library / Sir William Beechey 5.

All other images © Dorling Kindersley
For further information see:
www.dkimages.com

“THE NEXT BEST THING TO GOING TO A MUSEUM TO SEE THESE ITEMS FOR YOURSELF.”

— ARMCHAIR GENERAL MAGAZINE

Flint arrowhead

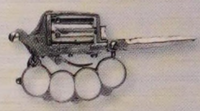
Apsis shield

Viking axhead

Proto mortuary sword

Spanish cavalry pistol

Rast and Gasser M1898 pistol



Dolne Apache pistol

Tokarev TT pistol

Military History is the ultimate visual chronicle of the ever-changing technology of warfare.

Features more than 1,750 pieces of hardware—from the earliest flint hand axes to the unmanned drones employed by today’s armed forces.

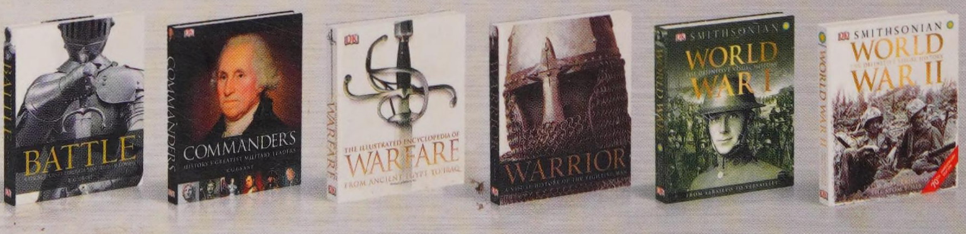
•

Chronicles key advances in technology, along with the weaponry and strategies of significant conflict situations.

•

Produced in collaboration with experts from the Smithsonian Institution, the Royal Armouries, and other leading museums.

Also from DK



$29.99 USA
$38.99 Canada

Smithsonian

The **Smithsonian** is the world’s largest museum and research complex dedicated to public education, service, and scholarship in the arts, sciences, and history.

ISBN 978-1-4654-3608-5 Printed in China

52999

9 781465 436085

www.dk.com

Jacket images: *Front:* **akg-images:** 35; **Alamy Images:** David J. Green 29, Susan & Allan Parker 25, Photos 12 31, Stocktrek Images, Inc. 30; **Ancient Art & Architecture Collection:** 2; **Bridgeman Images:** Private Collection / Photo © Agnew's, London, UK 37; **Corbis:** 39, Bettmann 40, Araldo de Luca 33, Skyscan 26; **Dorling Kindersley:** Courtesy of 4hoplites 10, Courtesy of the Royal Artillery Historical Trust 21, Museum of London 9, © The Board of Trustees of the Armouries 4, 12, 13, Second Guards Rifles Division 16, Christopher Seidler 6, Wallace Collection, London 3; **Getty Images:** The Bridgeman Art Library / Sir William Beechey 38, Imagno 36, MPI 34; **RMN:** Paris - Musée de l'Armée 18; © **Royal Armouries:** 5, 7, 8, 11, 15, 19; *Back:* **Dorling Kindersley:** Courtesy of 4hoplites 2, Museum of London 1, © The Board of Trustees of the Armouries 4, 5, Second Guards Rifles Division 8; © **Royal Armouries:** 3, 7; *Spine:* **Corbis:** 6; **Dorling Kindersley:** Wallace Collection, London 1. All other images © Dorling Kindersley. For further information see: **www.dkimages.com**